

# Understanding and supporting Personal Information Management across multiple platforms

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BA-BComp (Hons)

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# Declarations

## Originality

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# Abstract


THE research described in this thesis updates and extends Personal Information Management (PIM) scholarship to account for its cross-platform nature. In doing so, it explores the role of the tablet and similar emerging mobile technologies, and makes design recommendations, validated through prototype development and evaluation, for future PIM-tools to support cross-platform and tablet-based PIM.

In the past decade, PIM has evolved from an activity that largely takes place in the confines of an office, using paper and a personal computer, to a mobile activity involving multiple platforms, such as smartphones and tablets. PIM relates to the acquisition, organisation, maintenance, and retrieval of information —paper documents, files on computers, tablets, and smartphones —and is a constant source of every day challenges and roadblocks for many office-based knowledge workers. Significant research has been devoted to improving specific PIM-tools, such as email or web bookmark management, exploring the ways in which workers organise physical offices, or explorations of the ways that people browse or search their personal information collections. Many of these studies, however, do not contribute to PIM knowledge beyond the specific PIM-tool that they target, or lack a deep empirical grounding in their conception of PIM behaviours. Similarly, the role of emerging, yet rapidly adopted consumer technologies remains largely unexplored, much less in the context of myriad other PIM-platforms workers use to create, manage, and work with their information.

Inspired by techniques commonly  employed for user-centred design (UCD), PIM is explored here through three phases. The phases presented employ a variety of data collection tools and grounded-theory based analysis methods. Addressing the shortcomings of past research, this thesis builds a detailed picture of the nature of PIM, with a focus on cross-platform PIM involving tablets. This picture is used as an empirical basis upon which to build an understanding of the tablets and cross-platform PIM, the development of prototypes, and the extension of existing conceptual representations of PIM to account for the new understanding. 

Data collection was performed through multiple tools, including online questionnaires, semi-structured interviews, and a case study involving diary studies, prototype deployment with mediated data collection (automatic software logging), and further interviews. Data was analysed using a systematic social research method, combining a grounded theory-based analysis with initial thematic analyses. This work reports on the unique ways in which transfer is performed between the tablet and other PIM-platforms, the role of the tablet in PIM, user experience problems with existing software PIM-tools and the tablet, and recommendations for PIM-tool design

and evaluation.

Findings of the research allow for a deeper understanding of PIM in general, provide a rich understanding of the role of the emerging mobile technologies, and provide new guidance on the design of PIM-tools to serve an increasingly fragmented, cross-platform world. 

The major contributions, at the three levels, offered by this work include: **observations on the role of the tablet in PIM, the cross-platform nature of PIM**, the design and successful evaluation of several PIM-tool prototypes, and a pragmatic application of varied social research methods as means of analysis. The work also provides guidance on appropriate methods for the evaluation of future PIM-tools. A popular conceptual model of PIM is also extended and evolved to allow for its use with cross-platform PIM; this extension is explored and evaluated through the PIM-tool prototypes.



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*Information is a source of learning. But unless it is organized, processed, and available to the right people in a format for decision making, it is a burden, not a benefit.*

—C. William Pollard



# Introduction

## 1.1 Introduction



CROSS-PLATFORM personal information management (PIM) is an under-studied and misunderstood facet of the field. PIM is a core activity in the daily lives of many people, particularly those employed in roles that are classified as knowledge workers (Jones and Teevan, 2007; Jones, 2012). PIM is an umbrella term that refers to the collection of activities involved in the acquisition, organisation, maintenance, and later use of information (Barreau, 1995). Cross-platform PIM refers to activities conducted or related to multiple PIM-platforms, such as between a desktop computer and a tablet computer.

PIM is closely related to its constituent terms — information and management — as well as the fundamental issues of turning information into knowledge. "Information" is "an assembly of data in a comprehensive form capable of communication and use" (Feather and Sturges, 2003); information is not objective, and is the outcome of a individual using, understanding, or interpreting data (Lueg, 2002). "Management" is "the process of dealing with or controlling things" (noun) and "to be in charge of an undertaking, to administer, to regulate" (verb) (Dictionary, 1989). Regardless of the context — personal, or otherwise — turning information into knowledge requires the effective management of the information. Some would argue that you cannot manage information, only data; this distinction is irrelevant here. This research focuses on information in the physical domain — marks on paper, as it were, that carry meaning for one or more people — and information in the digital domain — arrangements of bits that likewise carry meaning.

Information Management (IM) relates to the management of information at an organisational level (Feather and Sturges, 2003). This is sometimes referred to as *knowledge management* (KM) when in the context of a very large institution (Wilson, 2002). IM

and KM are similar to PIM in that they typically involve the acquisition, organisation, maintenance, and retrieval of information, but that is where the similarities end; PIM is concerned solely with an individual.

PIM, as a field of study, has emerged from an organisational need to handle information. PIM emerged from IM, which is often the focus of company-wide endeavours to provide for the more efficient transaction of information, and information to knowledge, to be a field of its own involving the study, exploration, and improvement of the ways in which individuals management information that is directly under their control. IM involves the collection and management of information, from multiple sources, and for multiple audiences (Hedberg, 1979). IM is concerned with the rights to the information, the organisation of the information, the processing of the information, and the evaluation and use of the information (Hedberg, 1979; Wigand et al., 1997).

As technology became more embedded in society, IM became more complicated and moved from an activity that could be performed by administrative employees with little special training — largely involving paper documents — to the management of a complex conglomeration of paper documents, document files, tools, and technology (Hedberg, 1979; Davenport and Prusak, 1997; Wigand et al., 1997). IM involves the organisation, retrieval, acquisition, and maintaining of information at scale, and whilst some — such as those in a library and information science domain — may have been exploring and managing information and information behaviour for decades, IM outside of that domain has only relatively recently become quite complex.

Broadly, both IM and KM have strong connections to PIM (Jones, 2012). It has been suggested that knowledge is "*information in action*" (O'Dell and Leavitt, 2004) and that information is "*data in motion*" (Jones, 2012). Technically, IM came first, and was followed by the related but separate KM; Jones (2012) argues that knowledge is something that can only be managed through the management of information. Whilst this study is solely concerned with PIM, it is important to acknowledge IM and KM — which are typically organisation-level domains, concerned with businesses and their ilk — as issues that are first seen in organisational contexts often migrate to PIM (Jones, 2012). Some, such as Wilson (2002), have even suggested that KM is an umbrella term for a wide variety of organising activities, of which none actually relate to managing knowledge!

PIM is of paramount importance to knowledge workers (Jones, 2012), as the processing, use, and consumption of information is a primary task of their working day (Drucker, 1959). Knowledge workers need efficient access to their personal information in order to get things done (Reinhardt et al., 2011); this observation sounds straightforward enough on the surface, however decades of research into efficient



PIM suggests that this is anything but straightforward (Malone, 1983; Barreau, 1995; Whittaker and Sidner, 1996; Boardman, 2004).



**Figure 1.1:** *An example of a present-day office/desk with myriad platforms and tools*

Knowledge workers turn information into knowledge, typically by performing PIM activities, to ultimately communicate, process, or otherwise disseminate knowledge on a daily basis (Drucker, 1959). This means that PIM is a substantial chore, continually poorly supported by technology, and with a deep impact upon their work productivity when it is problematic (Malone, 1983; Barreau and Nardi, 1995; Whittaker and Sidner, 1996; Bellotti and Smith, 2000; Sellen and Harper, 2003; Jones et al., 2005; Jones, 2012; Detraux and Scapin, 2013).

As consumer computer technology increasingly permeates society (Gupta and Prinzing, 2013; Bharadwaj et al., 2013), so PIM has evolved from an activity largely restricted to filing cabinets, and other traditional office accoutrements to one involving a much broader collection of platforms and tools: paper documents, files on computer, content on tablets, smartphones, email, calendar items, tasks, contacts, amongst many others (Jones, 2012; Detraux and Scapin, 2013). PIM is happening on more platforms, using more tools, and more software than ever before. Office workers are increasingly being allowed — and in some cases encouraged — to bring their own devices ("BYOD") to work (Thomson, 2012a; Hayes and Kotwica, 2013), resulting in even more PIM-platforms for them to operate within the office.

Of particular interest to the researcher is the increasingly prevalent PIM-platform of the modern tablet computer, such as those shown in Figure 1.2 (Kaur, 2013; ACMA, 2013) running Google's Android operating system or Apple's iOS operating system (Thiruvathukal, 2013). An early-2013 study suggests that 34% of adults in the United

States own a modern tablet computer ([Pew Research Centre, 2013](#)), and at the time of writing the marketshare of Apple's iPad alone has been estimated to sit around 80% ([Cusumano, 2013](#); [Tellis, 2013](#); [Kaur, 2013](#); [ACMA, 2013](#)).



**Figure 1.2:** Popular contemporary tablet computers

This cross-platform, cross-tool ([Boardman, 2004](#)), tablet-filled landscape of PIM, where individuals manage, create, and transfer items of information through a variety of PIM-platforms and PIM-tools, presents a particularly notable and little studied facet of PIM. As this cross-platform PIM is increasingly common ([Jones, 2012](#); [Google, Inc., 2012](#)), it presents a compelling area for design and research.

The presentation of PIM in newspapers, magazines, television, and media add useful perspectives to this work. This uncritical presentation of PIM is useful in this research, since most practitioners of PIM are influenced by, and form their opinions of PIM, and how they should conduct it through their exposure to popular culture. PIM in popular culture is typically portrayed as a painless, almost enjoyable affair, consuming very little time out of the work day, and certainly not causing any concern or stress. The biggest culprits of this are television shows featuring both the medical ([Pfau et al., 1995](#)) and legal ([Chase, 1986](#); [Pfau et al., 1995](#)) professions;<sup>1</sup> the role of such television shows in constructing consumers' reality ([O'Guinn and Shrum, 1997](#)) results in people stressing that they are not as efficient as the knowledge workers

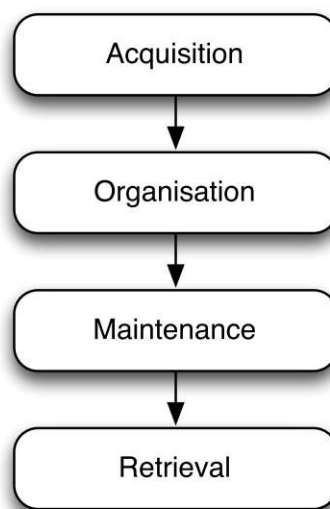
<sup>1</sup>Such as *Boston Legal*, *House*, and similar shows.



they see in action on fictional television programs. Cross-platform PIM, particularly, is typically portrayed as painless and swift, requiring little-to-no thought to move information between platforms, work with multiple computers, tablets, and collections of paper. This, perhaps, is as much a byproduct of media portrayals as it is a product of management rhetoric, but it is nonetheless worth mentioning.

In past research, PIM is often discussed through the structure of a conceptual framework or model (Jones et al., 2012). Barreau's (1995) model — shown in Figure 1.3 — for example, which divides PIM into four sub-activities (acquisition, organisation, maintenance, and retrieval) has been one of the most popular in past research, used in a variety of studies in a number of contexts (e.g. Keller et al., 1997; Bergman et al., 2003; Boardman and Sasse, 2004; Tenopir and King, 2004; Bernstein et al., 2008; Jones, 2012).

A range of such models exist, designed for use in a different contexts of PIM, but no model or framework exists to describe the particular facets involved in cross-platform PIM; this is discussed further in Chapter 2.



**Figure 1.3:** Barreau's (1995) four stage conceptual model for PIM

This research is concerned with the challenges of cross-platform PIM; specifically, it is concerned with the premise that *there is insufficient research exploring modern cross-platform PIM performed by knowledge workers*. Building on Barreau's (1995) model, by exploring cross-platform PIM, this work will also identify the facets of cross-platform PIM necessary to build a conceptual model suitable for use in future research and product development. As is discussed below, and later in Chapter 2, the lack of existing research into the use of tablet technology for PIM led to the inclusion of modern tablet computers as a focal point and lens for the research.

### 1.1.1 Chapter Structure

The remainder of this chapter introduces and sets the scene for the research through the following sections:

- [Section 1.2](#) presents the research problem, objectives, and scope;
- [Section 1.3](#) summarises the approach taken for the research;
- [Section 1.4](#) summarises the terminology used in the thesis, the contributions ultimately made by the work, publications arising from the research presented, and the structure of the thesis.

## 1.2 Research Premise

The overarching and initial premise of this research is that *there is insufficient research exploring modern cross-platform personal information management (PIM), as performed by knowledge workers*.

With this premise in mind, a review of context and literature was conducted; this is reported on in [Chapter 2](#). This gave rise to a number of observations on the fields of research and industry related to this premise. The key observations were:

- there was a lack of research into the use of tablet technology for PIM;
- there was a lack of research into the practice of cross-platform PIM;
- specifically, little is known about the relationships between different PIM-platforms, and the differing ways in which they are used;
- the "research-practice gap" ([Sutcliffe, 2000](#); [Rogers, 2004](#)), where research outputs can be irrelevant to the real-world needs, is ominously lurking throughout PIM research ([Kljun et al., 2013](#)).

The premise, together with these observations, led to the development of three high-level objectives and a number of considered scope constraints for the research. These are now presented in the following two sections:

- [Section 1.2.1](#) documents the high-level objectives of the research;
- [Section 1.2.2](#) reports on the scope constraints imposed on the work.

### 1.2.1 Objectives

The three high-level objectives of the research presented in this thesis, as developed from the initial premise and the observations arising from the literature review noted above, were:

1. *To develop an understanding of cross-platform PIM, and PIM practices involving modern tablet technology:* the research sought to build an understanding of modern cross-platform PIM, through the lens of the tablet platform. The research sought to determine how tablets were used for PIM, the challenges faced by users of tablets for PIM, and the ecosystem of PIM-tools and PIM-platforms that the tablet is used in.
2. *To propose and evaluate an empirically-grounded model of cross-platform PIM:* the research sought to provide a conceptual model as a means for discussion of cross-platform PIM or elements of cross-platform PIM, which could be utilised to describe and explain future empirical observations and PIM-tool evaluations. It was anticipated that tablet technology would be used as the exemplar for the model.
3. *To propose, implement, and evaluate a number of prototype software PIM-tools that address typical cross-platform PIM challenges:* the research sought to develop a number of prototype software PIM-tools that would directly address one or more of the challenges identified through the study.

### 1.2.2 Scope

The researcher felt that it was important to appropriately constrain the scope of the research from the outset. Therefore, the scope of the research was initially constrained as follows:



1. *To focus on the activities of knowledge workers in their workplace:* A focus on knowledge workers, skilled workers who effectively turn information into knowledge, meant that there was a high likelihood that participants would require effective PIM in order to accomplish their jobs. It was felt that this would facilitate a more productive discussion of PIM with participants.
2. *To focus on cross-platform PIM through the lens of tablet computers:* To focus on cross-platform PIM without a specific platform as a lens was deemed too large in scope, and the tablet computer presented as a highly relevant, little studied lens —as compared to, for example, smartphones —with which the researcher had





significant experience (e.g. [Goldstein et al., 2010](#); [Buttfield-Addison and Manning, 2012](#));

3. *To focus on the high-level activities of cross-platform PIM*: A focus on the high-level activities of cross-platform PIM, rather than the low-level minutia of specific PIM-tools.

## 1.3 Research Approach

The approach taken for this research differs in tone from many other PIM research projects reported on in recent years. The proceedings of related conferences, PIM workshops, and similar events, reveal a distinct turn towards such areas as the exploration of social contexts in PIM (e.g. [Tungare, 2012](#); [Sawyer et al., 2012](#); [Teraoka, 2012](#); [Zhang and Twidale, 2012](#)), highly specific sub-fields of PIM (e.g. [Beaver-Seitz and Russell, 2010](#)), requirements analysis for specific software PIM-tools (e.g. [Sajedi et al., 2012](#); [Shapiro et al., 2012](#)), and life logging, or personal analytics (e.g. [Kelly et al., 2009](#); [Beaver-Seitz and Russell, 2010](#)). These areas, whilst fascinating and worth of study, do little to increase our understanding of the broad range of daily activities, platforms, and tools performed and used by people in the course of managing personal information in the context of their workplace and workspace.

This thesis seeks to help redress this imbalance by deliberately exploring the use of, and needs surrounding cross-platform PIM broadly, eschewing collaborative activities and the social contexts of PIM, life-logging, and premeditated software PIM-tool design ([Jones, 2012, 2013](#)) in favour of exploring the requirements, activities, and challenges faced by individuals who are working in an increasingly cross-platform PIM environment. The philosophy of the research approach, and the agenda developed from this philosophy, are now discussed in the following two sections:

- [Section 1.3.1](#) summarises the overall research philosophy;
- [Section 1.3.2](#) presents an overview of the research agenda.

### 1.3.1 Philosophy

It has been argued that there are two fundamental categories of PIM research ([Rogers, 2004](#); [Boardman and Sasse, 2004](#)):

1. design-focused, exploratory projects, typically driven by a goal of prototyping, and;
2. empirically grounded studies of activities, goals, and behaviours.

Design-focused PIM research is typically concerned with the prototyping and conception of new interfaces for PIM, and is largely focused on the creation of software. The research in this category can typically be situated within one of three sub-categories:

1. expanding the functionality of an existing tool;
2. consolidating information types within a single tool or interface, and;
3. attempting to create an entirely new type of information.

Empirically grounded studies of PIM are typically concerned with exploring a highly specific sub-set of PIM, such as the management of email or web bookmarks (Boardman and Sasse, 2004; Elswailer et al., 2011), and do not contribute to a body of systematic knowledge (Boardman, 2004; Jones, 2012). These studies also typically lack any form of reusable theoretical output, and often use dubious evaluation metrics (Jones, 2012).

This thesis focuses on addressing the lack of past research into three specific, yet disparate areas:

- cross-platform PIM;
- tablet computers and PIM;
- reusable theoretical output.

As is discussed in Chapter 2, there is little research on the role of tablet technology in real-world PIM. Most notably, there is no empirically grounded exploration of how, and why, knowledge workers make use of tablets for managing, and making use of, documents in their personal information collections. Because of this, any understanding of modern PIM is flawed by omission.

More broadly, cross-platform PIM, while implicitly acknowledged as a source of challenges for knowledge workers by past research (Jones, 2012), similarly has little in the way of an empirically grounded research basis. This study addresses the research gap by exploring the role of the tablet in PIM.

The focus of this research is cross-platform PIM, centred around tablet technology and concerned with the activities of knowledge workers. It seeks to make a number of recommendations for the development of PIM-tools to support this manner of PIM.

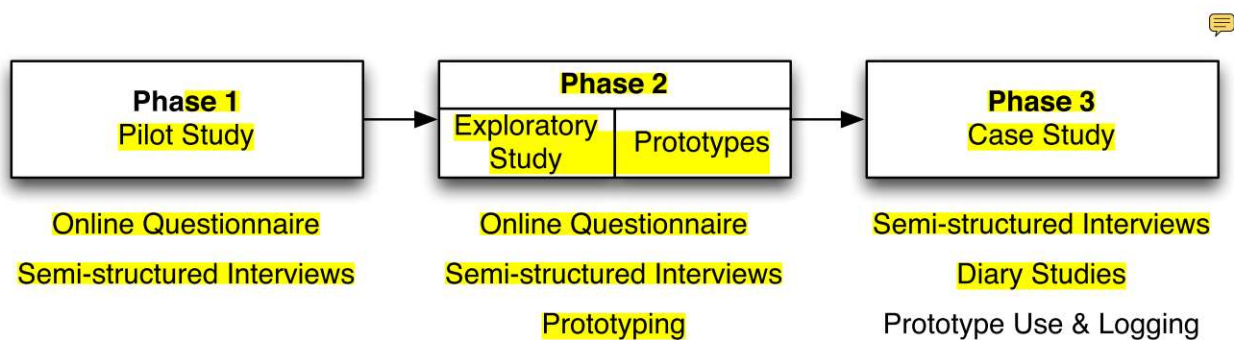
Requirements gathering, followed by design and evaluation of PIM-tools is a typical approach used by past research to explore the field of PIM (Jones, 2012), however there exists only an initial foundational set of research on the effective evaluation of PIM-tools (Jones and Teevan, 2007; Kelly and Teevan, 2007; Jones, 2012; Diekema,



2012). Whilst this thesis is not focused solely on the design and evaluation of PIM-tools, it does also seek to provide a number of recommendations concerning the effective evaluation of PIM-tools for research.

### 1.3.2 Agenda

The research would begin with an investigation of the research context via a review of past literature. This is reported on in Chapter 2. Following this, the research was conducted over three phases. The sequence is shown in Figure 1.4 and detailed following:



**Figure 1.4:** The three phases of the research, following from the literature review. The instruments used in each phase are also listed

#### Research Context Literature Review

The first component of the research was a review of past literature and consumer material relating to PIM and tablet technology. The literature review was intended to provide the conceptual grounding for the research and critically review prior research in allied fields in order to validate the research agenda.

The core objectives of the literature review were:

1. identify gaps in related research and industry;
2. identify both strengths and shortcomings in the approach of past research;
3. identify appropriate ways to constrain the scope of the research.

#### Phase 1 Pilot Study

The first phase of the research was a pilot study designed to provide an empirical basis upon which the first and second objectives of the research could begin to be addressed.

The pilot study had two components:

1. an online questionnaire, designed to identify the PIM-platforms and PIM-tools most commonly used by knowledge workers alongside tablets, and to provide the first pieces of information for identifying the most prevalent challenges of cross-platform PIM;
2. a series of semi-structured interviews, designed to explore the identified PIM-platforms, PIM-tools, and challenges in more detail.

Analysis was conducted through multiple iterations of coding and theming using straightforward thematic analysis techniques.

The core objectives of the pilot study were:

1. to begin to understand the context in which tablets are used for PIM;
2. to identify the most prevalent PIM-platforms and PIM-tools used alongside tablets for PIM;
3. to identify the most significant challenges of cross-platform PIM, through the lens of tablet use.

### **Phase 2 Exploratory Study and Prototypes**

The second phase of the research was an exploratory study, followed by the development of a number of software PIM-tool prototypes. The exploratory study was designed to further build the empirical basis necessary for addressing the first and second objectives of the research, whilst the prototyping was designed to begin addressing the third objective using the findings developed by this point.

The exploratory study had two components:

1. an online questionnaire, designed to dive deeper into exploring the facets of tablet usage for PIM as reported by participants of Phase 1;
2. a second series of semi-structured interviews focused on gaining a deeper understanding of the particular problems of tablet-centric cross-platform PIM identified by participants of Phase 1.

Analysis was conducted using a multi-step iterative approach based on grounded theory methods ([Suddaby, 2006](#)). Following the analysis, both the design and construction of prototypes were conducted.

The core objectives of the exploratory study were:

1. to focus on, and further explore, the facets and challenges of cross-platform PIM involving tablets that were identified in the pilot study;

2. to build the empirical groundwork necessary to begin making recommendations for the construction of prototype software PIM-tools;
3. to provide the basis for an initial exploration of a conceptual model of cross-platform PIM, using tablets as an exemplar platform.

The core objectives of the prototype design and construction were:

1. to further explore one, or more, of the challenges faced by individuals who practise cross-platform PIM involving a tablet;
2. to develop a software PIM-tool prototype that allows for the exploration, and a deeper understanding of, cross-platform PIM and tablet technology;
3. to make initial recommendations regarding the evaluation of PIM-tools.

### **Phase 3 Case Study**

The third phase of the research was a case study of a small group of knowledge workers designed to solidify and finalise the observations and recommendations in support of all three thesis objectives.

The case study was composed of a number of semi-structured interviews and diary studies. Participants further discussed the challenges of cross-platform PIM that they faced, utilised the prototypes developed, reported their experiences, and provided further data on their conduct of PIM through log data.

Analysis was conducted using the same approach, based on grounded theory methods, as was used for the exploratory study ([Suddaby, 2006](#)).

The core objectives of the case study were:

1. to build and expand on the exploration of the facets and challenges of cross-platform PIM, and the use of tablets, that were identified in the pilot and exploratory studies;
2. to evaluate and explore the software PIM-tool prototypes;
3. to further build upon the conceptual model of cross-platform PIM, using tablets as an exemplar platform.

## **1.4 Reader's Guide**

This section provides a guide to the structure and context of both the thesis and the research as a whole. The guide is presented over the following sections:



- [Section 1.4.1](#) provides an overview of key terminology used in the work;  
[Section 1.4.2](#) lists the publications relating to the work;
- [Section 1.4.3](#) presents a guide to the contents of each chapter.

### 1.4.1 Terminology

A number of terms and abbreviations that are used in this thesis have specific meanings attached to them in the context of this work. This list is presented as a quick reference; these terms and abbreviations are all discussed further in the literature review in [Chapter 2](#):

- **Personal Information Management (PIM)**, refers to the efforts of knowledge workers to manage items of information, usually documents, under their direct control in their office environment ([Jones, 2012](#)).
- **Personal Information Management tools (PIM-tools)** are tools, typically software-based, that are designed to allow an individual to manage a collection of PIM-items. Typically, a PIM-tool will support each of the sub-activities of PIM as defined by [Barreau's \(1995\)](#) model. Examples of PIM-tools include, but are not limited to, email, digital files, and web bookmarks.
- **Personal Information Management platforms (PIM-platforms)** run PIM-tools and include personal computers, smartphones, tablets, wearables, and other technology ([Jones, 2012](#)). Paper is also considered a PIM-platform, but does not run software ([Jones, 2012](#)).
- **Cross-platform PIM** refers to PIM activities conducted or related to multiple PIM-platforms; similarly, **cross-tool** refers to PIM activities conducted across, or in relation to, multiple PIM-tools ([Boardman, 2004](#)).
- **Knowledge workers** refer to individuals whose primary activity is the development of knowledge from information ([Drucker, 1959](#)), knowledge workers think creatively, in a convergent, and divergent manner for a living ([Davenport, 2005](#)), spend a large amount of their work time managing, locating, and interpreting information ([McDermott, 2005](#)), and are largely autonomous in defining their working habits and environment [Cortada \(1998\)](#). Examples of knowledge workers include doctors, lawyers, teachers, or software engineers.

### 1.4.2 Publications

The researcher has published a number of papers arising from work reported on in this thesis:

- [Buttfield-Addison et al. \(2009\)](#) reported preliminary results from the pilot study reported on in [Chapter 3](#).
- [Buttfield-Addison et al. \(2012\)](#) reported on techniques employed by study participants in their practice of PIM using an iPad tablet.
- [Buttfield-Addison et al. \(2013\)](#) reported on classifications developed to represent iPad users during the exploratory study reported on in [Chapter 4](#).

The researcher has also published two technical books for which the topics formed the technical basis of the prototype construction reported on in [Chapter 5](#):

- [Goldstein et al. \(2010\)](#) discussed various software development techniques for Apple's iOS platform.
- [Buttfield-Addison and Manning \(2012\)](#) discussed software development techniques for both Apple's iOS platform, and Apple's OS X platform.

### 1.4.3 Thesis Structure

[Chapter 2](#) provides a review of the context of the work presented in this thesis, discusses relevant past work in the commercial and research domains, and provides a background to PIM in terms of relevant definitions and conceptual models referred to during the thesis.

[Chapter 3](#) reports on Phase 1, the pilot study which was conducted in order to build the initial understanding of the field in which this work is situated, confirm the research focus, and set the scene for further studies comprised in this work.

[Chapter 4](#) reports on Phase 2, the exploratory study, focused on developing an understanding of the use of tablets in PIM, with particular reference to the challenges, common PIM-tools and common PIM-platforms identified in the pilot study.

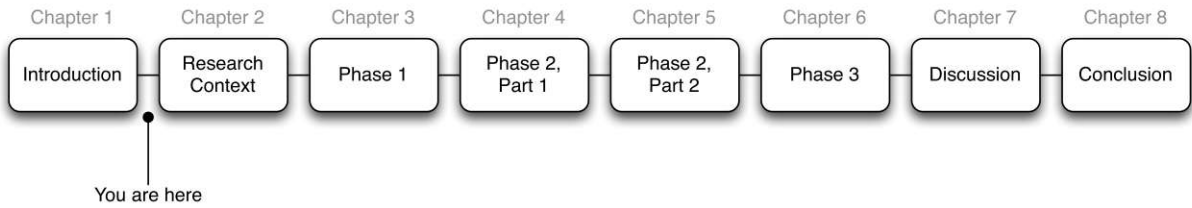
[Chapter 5](#) discusses the second component of Phase 2, the conception, design, and implementation of a collection of a number of software PIM-tools, designed to support and explore the particular challenges identified in the exploratory and pilot studies.

[Chapter 6](#) reports on Phase 3, the case study of knowledge workers which further explored the understanding of the tablet in PIM developed through the pilot study, exploratory study, and prototype construction, and evaluated the prototypes and conceptual models developed during the research.

Chapter 7 presents, discusses, and integrates the substantive findings of the previous four chapters.

Chapter 8 summarises the main findings and contributions presented in the thesis, discusses the limitations of the work conducted, and identifies future work by way of concluding the thesis.

For ease of reading, a summary of structure is provided in many sections of this work.







*PIM is the art of getting things  
done in our lives through informa-  
tion.*

—W. Jones

# 2

## Research Context

THIS chapter presents a critical review of the research context, which provides a conceptual grounding for the research presented in this thesis, defines key terminology, and establishes the situation of this work amongst past work in both the research and commercial domains.

### 2.1 Introduction

The definition of Personal Information Management (PIM) used by this research is not particularly complex, contentious, or confusing: PIM refers to *the efforts made by individuals to manage information under their direct control* (Jones, 2012); specifically, *"a person's methods and rules for acquiring information ... the mechanisms for organizing and storing the information, the rules and procedures for maintaining the system, the mechanisms for retrieval, and procedures for producing various outputs."* (Barreau, 1995; Barreau and Nardi, 1995)

In this case, the individuals in question are knowledge workers, the information is typically documents of various kinds, and the context in which the information is being managed is a workplace.

PIM is essentially an umbrella term that describes the processes used by individuals to *acquire, maintain, organise, and retrieve* information (Barreau, 1995). This thesis does not deeply concern itself with the distinction between the two domains in which PIM is typically conducted —to wit, the digital and the physical—but must acknowledge them and discuss them somewhat independently, as this demarcation is present in past research.

PIM researchers frequently begin reporting their work by discussing the fundamental human desire to collect things (e.g. Malone, 1983; Boardman, 2004; Jones, 2012). In this respect, this thesis is no different: humans do indeed collect things, both phys-

ical and digital; many are acquired intentionally, and many unintentionally. We typically keep objects if we perceive them to have some sort of value to us in the future (Jones and Teevan, 2007; Jones, 2012).

Significant time, effort, and money has been put into research and product development that supports the management of objects we collect. Specifically, artefacts and tools — such as the filing cabinet (Jones, 2012) — often inspire great advances, even revolutions, in the way specific classes of objects are managed. Norman (1993) discusses the cognitive scaffolding that is afforded by an effective artefact: the overhead of organising, or remembering how things are organised, is offloaded to the artefact. The *scaffolding minds* perspective (Clark, 2008), is a popular perspective on this, and the office desk is a popular example: desks are often used to “outsource” memory, through the accumulation of information in document form, and its position on the desk for reminding (Lueg, 2012).

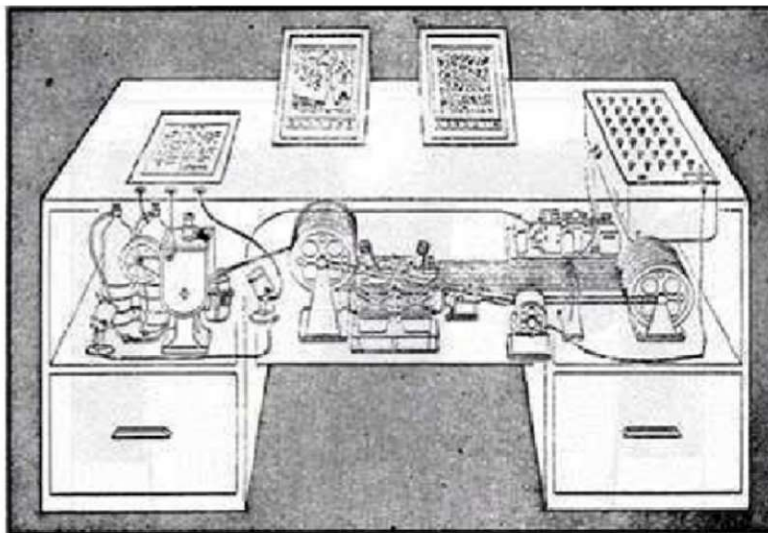


Figure 2.1: Bush's (1945) Memex, an early electronic PIM-tool

Much of the modern discussion of PIM can be traced back to Bush's (1945) work, in which a device — known as the “Memex”, and shown in Figure 2.1 — was proposed as “an enlarged intimate supplement to memory”. The “Memex” was conceived as a system in which people could store and index all their information such that it “may be consulted with exceeding speed and flexibility” (Houston and Harmon, 2007). It was, essentially, one of the first electronic PIM-tools.

Following this, through the work of others such as Newell et al. (1958) and Broadbent (1958) in the 1950s and 1960s, and as information processing, human behaviour and cognition, and intelligence augmentation research began to gain ground, there was a surge of interest in using computers to allow people to process information more effectively.



Researchers such as [Carmody et al. \(1969\)](#) and [Engelbart \(1963\)](#) worked on hypertext systems, and others, such as [Licklider \(1960\)](#), explored the potential for supporting human intelligence with machines. Then, following the rebirth of cognitive psychology (e.g. [Neisser, 1967](#)) —exploring the ability of people to learn things, remember, and to think —and as the personal computer came into the world in the 1970s ([Freiberger and Swaine, 1999](#)), PIM was truly born.

Many scholars (e.g. [Boardman, 2004](#); [Jones, 2012](#)) suggest that the phrase “*personal information management*” originated with [Lansdale \(1988\)](#). Regardless, it was in the 1980s that PIM truly emerged as a field —alongside the burgeoning human-computer interaction field (e.g. [Card et al., 1983](#); [Norman, 1988](#)) —with software “*PIM-tools*”, providing support for the management and organisation of everything from addresses to to-do lists ([Jones, 2012](#)). [Lansdale’s \(1988\)](#) work, which explored the psychological side of PIM —how people recall, remember, organise, and categorise —paved the way for more recent naturalistic explorations of PIM, which explored people’s activities in a natural setting, rather than more contrived laboratory scenarios (e.g. [Kelly, 2006](#); [Jones and Teevan, 2007](#); [Barreau, 2008](#)).



**Figure 2.2:** Popular modern tablet computers

The birth of the world-wide-web, and the introduction of a never-ending cavalcade of feature phones, smartphones, tablet computers, and personal digital assistants —examples of which are shown in [Figure 2.2](#) —has only served to stoke the fires of

revolution and evolution in both the research and commercial PIM domains (Boardman, 2004; Jones, 2012; Swallow, 2013). PIM is a constantly evolving field. Many researchers suggest that we are presently at an inflection point for PIM, moving from what Jones (2012) describes as a "Palaeolithic Age" of PIM to a "Neolithic Age": a point of advancement in our understanding and practice far above that which existed before.

Many opinions on the current state of the field, both commercial and academic, exist (Gyllstrom and Soules, 2008; Jones, 2012), but a common thread relates to ideas from the research domain not easily being ported to the commercial domain (Gyllstrom and Soules, 2008; Karlson et al., 2011). Opinions differ as to why this is the case; some claim that it is due to the existence and use of entrenched operating systems, whose rigid structure and ubiquity is difficult to overcome (Gyllstrom and Soules, 2008); others, such as Sutcliffe (2000) or Rogers (2004) suggest that it is due to a more general research-practice gap, where ideas from research — for any number of reasons — fail to move to other domains, such as the commercial (Kljun et al., 2013). Others, such as Kim (2013), suggest that it is because retrieval is the most commonly investigated aspect of PIM, leaving other facets, such as how people collect, organise, find, or archive information, by the wayside. Terras (2012) suggests that PIM studies have produced a significant body of research that *"suggests definite patterns of behaviour in personal creation, management, and use of information"*.

This chapter provides a critical review of past practice and theory related to the research in this thesis, and uses the common threads of the lack of research into cross-platform PIM, and the lack of ideas from research moving into the commercial domain as a basis for doing so. Definitions and justification of key terminology are presented, and basic concepts that underlie related fields, such as human-computer interaction (HCI), are presented. Notable research gaps are also highlighted in this chapter.

This work sits at the inflection point, and seeks — particularly — to begin to address the current lack of understanding surrounding cross-platform PIM. Before embarking on this, key terminology must be presented. An initial overview of the terminology used in this thesis was provided in Section 1.4.1. The remainder of this section reiterates those key definitions, and justifies their use.

**Personal Information Management** The ways in which various researchers describe and characterise PIM is fairly consistent, and generally maintains a similar core idea which has been built on over the years. Lansdale (1988), for example, defines PIM as *"the methods and procedures by which we handle, categorize, and retrieve information on a day-to-day basis"*. Building on this, Barreau (1995) defines PIM as *"a system developed by or created for an individual for personal use in a work environment"*, including *"a person's methods and rules for acquiring information ... the mechanisms for organizing and storing the*



information, the rules and procedures for maintaining the system, the mechanisms for retrieval, and procedures for producing various outputs". Later on, [Bellotti et al. \(2002\)](#) defines PIM as "the ordering of information through categorization, placement, or embellishment in a manner that makes it easier to retrieve when it is needed". More recently, [Jones \(2012\)](#) defines PIM as "the practice and the study of the activities a person performs in order to acquire or create, store, organize, maintain, retrieve, use and distribute the information needed to meet life's many goals ... and to fulfill life's many roles and responsibilities" and "the efforts made by individuals to manage information under their direct control".

Observing the various definitions, [Boardman \(2004\)](#) notes that "many definitions of PIM draw from a traditional information management perspective —that information is stored so that it can be retrieved at a later date".

The work presented in this thesis draws primarily from [Barreau's \(1995\)](#) definition of PIM, with the focus strictly upon PIM conducted with an individual's working environment.

**PIM-tools, PIM-platforms, and cross-platform PIM** The terms *PIM-tool* and *PIM-platform*, as used in this thesis, are not extraordinarily common in past PIM research. They do, however, refer to concepts that are consistent with past work.

*Personal Information Management tools (PIM-tools)* are tools, typically software-based, that are designed to allow an individual to manage a collection of information. Typically, a PIM-tool will support each of the sub-activities of PIM as defined by [Barreau's \(1995\)](#) model. Examples of PIM-tools include, but are not limited to, email, digital files, or web bookmarks.

*Personal Information Management platforms (PIM-platforms)* run PIM-tools and include personal computers, smartphones, tablets, wearables, and other technology ([Jones, 2012](#)). Paper can also be considered a PIM-platform, but one that does not run software ([Jones, 2012](#)).

*Cross-platform PIM* refers to PIM activities conducted or related to multiple PIM-platforms, while *cross-tool* refers to PIM activities conducted across, or in relation to, multiple PIM-tools ([Boardman, 2004](#)).

**Knowledge worker** *Knowledge workers* are individuals whose primary activity is the development of knowledge from information ([Drucker, 1959](#)), knowledge workers think creatively, and in a convergent, and divergent manner for a living ([Davenport, 2005](#)), spend a large amount of their working time managing, locating, and interpreting information ([McDermott, 2005](#)), and are largely autonomous in defining their working habits and environment [Cortada \(1998\)](#). Examples of knowledge workers include doctors, lawyers, teachers, or software engineers.



### 2.1.1 Chapter Structure

The remainder of this chapter is structured around the key facets of the research:

- [Section 2.2](#) reviews the current status of Personal Information Management (PIM) and related domains, exploring past literature, commercial endeavours, and current popular practice and products;
- [Section 2.3](#) reviews and discusses the tools used for researching and thinking about PIM and similar fields;
- [Section 2.4](#) presents a critical review of past research, and a discussion of the context in which the research is situated;
- [Section 2.5](#) reviews the research premise and approach, explaining updates and revisions made to the research goal and design based on the content uncovered during the review of research context;
- [Section 2.6](#) concludes the chapter with a summary and brief commentary.

## 2.2 Personal Information Management

This section explores the current state of PIM by looking at the two distinct domains of PIM —physical PIM and digital PIM —as well as various theoretical presentations related to PIM, relevant PIM products in the commercial domain, and how PIM is presented in popular culture. The remainder of this section is structured as follows:

- [Section 2.2.1](#) explores past work relating primarily to physical PIM;
- [Section 2.2.2](#) assembles a picture of the state of digital PIM;
- [Section 2.2.3](#) summarises theory relevant to explorations of PIM;
- [Section 2.2.4](#) reviews popular software PIM-tools in the commercial domain;
- [Section 2.2.5](#) concludes the section with a summary of domains related to PIM.

### 2.2.1 Physical PIM

This section explores past research in the domain of physical PIM: PIM conducted using information in physical form —that is, mostly paper. Physical PIM is explored by highlighting a number of publications that are either seminal in the field, or explore highly important, or otherwise untouched elements of it.

The majority of past PIM research acknowledges Malone's (1983) study *"How Do People Organize Their Desks?"* as the seminal work of PIM; Malone (1983) explored the use of paper files in offices, identifying two organising strategies: *"neat"* and *"messy"*. Neat individuals attempted to categorise and file all the documents that they maintained, whilst messy individuals tended to pile up documents over time, in a less structured manner, as shown in Figure 2.3. A key conclusion of the work was that organising information is done not just to allow for the finding of the information in the future, but also to assist in reminding of future tasks that must be performed (Malone, 1983). This observation has been reiterated by later research (e.g. Frohlich and Perry, 1994).



Figure 2.3: A typical pile of paper in an office

A little earlier, however, Cole (1982) also explored how people organise their offices, focusing on the factors which influence information storage and retrieval behaviour, and concluded that people had little motivation to maintain even slightly complicated filing systems, preferring instead to store and retrieve information based on its location, rather than categories or other semantics (Cole, 1982; Henderson, 2009a). Additionally, Cole (1982) suggested that there are three types of information: *action information*, *personal work information*, and *archived information*. Each of these different information types has different organisation needs: action information is rarely organised, archived information is most commonly categorised, and personal work information a combination.

Later, Kwasnik (1989), also seeking to explore how offices are organised, suggested that there are 35 dimensions, in seven loose groups, used by people when they talk about physical documents in their offices:

*"Situation Attributes, such as source, use, circumstance, and access; Document*



*Attributes, such as author, topic, and form; Disposition, such as discard, keep, postpone; Order/Scheme, such as group, separate, and arrange; Time, such as continuation, duration, and currency; Value, such as importance, interest, and confidentiality; and Cognitive State, such as 'don't know,' and 'want to remember.'"*

Categorisation with attributes, such as these, is a popular approach in past PIM research as it allows researchers to build upon a familiar set of descriptions for common facets of PIM. The most commonly used categorisations appear to be in line with the "piling" and "filing" concepts developed by [Malone \(1983\)](#). A number of studies, such as [Jones and Thomas \(1997\)](#), suggest that computer-based PIM-systems are rarely considered alongside paper-based PIM, leading to a lack of exploration of software PIM-tools to support paper-based PIM.

Later still, [Whittaker and Hirschberg \(2001\)](#) explored the use of paper for PIM in a research lab, concluding that "piling" techniques were superior to "filing" techniques in terms of ease of access to recent information and ease of cleaning up, but that they did not scale to larger information collections. Filing can inspire "premature filing", where things that have questionable value are filed, creating difficulties for later retrieval. [Whittaker and Hirschberg \(2001\)](#) also suggested that large archives are useful, and that people deliberately maintain large archives and refer to them frequently. This contrasts with some past work, such as [Kidd \(1994\)](#), which has suggested that once information has been used it is no longer needed.

[Bondarenko and Janssen \(2005\)](#) reports on a study that crosses the barrier between the physical and digital domains of PIM, commenting that digital tools fail to adequately support the context in which information is used and re-contextualisation performed as a task is carried out, whereas paper supports these needs much better. [Bondarenko and Janssen's \(2005\)](#) work concludes with six recommendations for the design of digital PIM-tools that combine the advantages of the physical and digital domains; these recommendations largely revolve around the fact that documents are usually thought of in a task-related context, are often used in concert with other documents, and should require as little cognitive effort as possible to work with.

### 2.2.1.1 Summary

Explorations of physical PIM in the research domain focus primarily on understanding and categorising the different techniques people use in the organisation and maintenance sub-activities of PIM. Three key observations arise from reviewing the state of the physical PIM domain, they are:

- paper is often considered to better support the context in which information is used, and the re-contextualisation performed as a task is carried out, than most



software PIM-tools running on digital PIM-platforms ([Bondarenko and Janssen, 2005](#));

- the majority of past research focuses upon classifying the habits and practices of people practicing physical PIM;
- few studies explore the relationship between the physical and digital domains of PIM.

In summary, the physical domain of PIM has a small number of relatively influential researchers (e.g. [Malone, 1983](#), and those who built off his work) — the focus tends to be on understanding how people use paper in order to influence the design of digital PIM-tools ([Jones, 2012](#)). However, the research domain — especially in recent years — is fairly limited.

### 2.2.2 Digital PIM

This section builds on the previous section, discussing past research in the domain of digital PIM, and PIM conducted using electronic PIM-tools, on electronic PIM-platforms, such as computers, smart phones, and tablets. Digital PIM is explored by highlighting a number of publications that are either seminal in the field, or explore highly important or otherwise untouched elements of it.

A large amount of past research into digital PIM has involved examinations of the file system or functionality of desktop operating systems (e.g. [Akin et al., 1987](#); [Mander et al., 1992](#); [Barreau, 1995](#); [Barreau and Nardi, 1995](#); [Kaptelinin, 1996](#); [Boardman and Sasse, 2004](#)), email (e.g. [Mackay, 1988](#); [Whittaker and Sidner, 1996](#); [Ducheneaut and Bellotti, 2001](#)), internet bookmarks, image collections, instant messaging collections, voicemail, and electronic address books (e.g. [Abrams et al., 1998](#); [Whittaker et al., 2000](#); [Jones et al., 2001](#); [Whittaker et al., 2002](#); [Isaacs et al., 2002](#); [Dix and Marshall, 2003](#); [Rodden and Wood, 2003](#); [Kirk et al., 2006](#)). As this study is concerned with the management of personal information across multiple platforms, which by its nature involves a multiplicity of tools, a wide variety of relevant points can be drawn from this literature.

The remainder of this section —in addition to discussing digital PIM broadly — summarises three well-researched facets of digital PIM:

- email;
- bookmarks;
- digital documents.

**Studies of Email** Email is perennially one of the most popular facets of PIM to study. Inspired by Malone's (1983) work, Mackay (1988) classified email use techniques in a similar way, identifying *"requesters and responders"* as those who use email for task delegation, *"prioritizers"* as those who attempt to manage incoming messages, and *"archivers"* as those who file away emails for future use.

Whittaker and Sidner (1996) specifically explored organising behaviours around email, identifying *"frequent filers"* as those who attempted to maintain all their emails in folders, *"spring cleaners"* as those who file emails into folders on a periodic basis, and *"no filers"* as those who allow their email to collect in the inbox. *"No filers"* typically relied on search, as well as the temporal ordering of emails, in order to retrieve the emails for use. Bälter (1997) extended these classifications, noting that *"no filers"* could be divided into *"folderless cleaners"* and *"folderless spring-cleaners"*, based on the frequency they cleared out the inbox.

Gwizdka (2004) continued to classify email use techniques, describing *"cleaners"* and *"keepers"* as those who allocate specific times to work with their email, not using email as a reminder system or to-do list, and those who constantly work with their email, allowing themselves to be frequently interrupted by new email, but also using email as an event and to-do reminder system, respectively.

*"Email as a habitat"* was discussed by Ducheneaut and Bellotti (2001), who found that since email is a central form of document exchange it is frequently used as a document storage repository. They also observed that users employed workarounds, such as naming folders in specific ways, in order to force email clients to serve them in certain ways by virtue of their sorting features.

**Studies of Bookmarks** Again, as with physical PIM, the preponderance of attempts to classify and categorise attributes identified can be seen in the digital PIM domain as well. Similar approaches have been reported in studies of user practice of web bookmarking, such as Abrams et al.'s (1998) study of web browsing and bookmarking habits, in which the archetypes of *"no filer"*, *"creation time filer"*, *"end of session filer"*, and *"sporadic filer"* were identified.

Boardman and Sasse (2004) explored PIM in a cross-tool sense, following on from Boardman (2004) and Boardman (2001), comparing the behaviour found across email, bookmarks and digital documents; they found that web bookmarks were the most neglected, with people spending more effort —likely because it was more complicated—organising their digital documents and emails.

**Studies of Digital Documents** Barreau and Nardi's (1995) work, which explored how people file, organise, and remind using digital document files, is one of the most in-



fluent and controversial (Fertig et al., 1996a) studies of digital documents. It found that users preferred browsing to search, placed files in certain locations in order to allow them to serve as reminders, and that users did not consider archiving of importance. Continuing the classification and categorisation trend in PIM research, it also suggested that there are three specific types of information: *ephemeral*, *working*, and *archived*. Fertig et al. (1996a) rebuffed Barreau and Nardi's (1995) findings, suggesting that they were artefacts of desktop computing and file and folder metaphors. Nardi and Barreau (1997) defended the conclusions of Barreau and Nardi (1995), citing that the lower cognitive burden of browsing until something is recognised rather than attempting to remember a precise filename was a well established preference amongst users (e.g. Lansdale, 1988). The suggestion that files are not named in a manner such that supports recalling the exact file name in future, as well as the preference for location-based browsing imbuing a sense of control with the user, are worthy of consideration (Barreau and Nardi, 1995).

A software PIM-tool is a system that allows an individual to work with a collection of personal information; the PIM-tool defines the interface to the collection. A PIM-tool should provide support for all four sub-activities of PIM (Barreau and Nardi, 1995; Boardman, 2004): the ability to acquire, organise, maintain, and retrieve information. Warren (2013) explores the requirements for PIM-tools, arguing that most current tools do not meet three core needs:

1. combatting information overload (Jones, 2012, 2013);
2. easing context switching;
3. supporting integration.

Warren's (2013) work makes a number of recommendations for the development of future PIM-tools that can support these core needs in the context of a file system and a set of digital documents. They are:

1. the use of a unified file system;
2. the use of tagging, in a backwards compatible manner for existing file systems;
3. the use of context to aid information retrieval, built upon existing file and tagging systems, rather than creating a parallel context management system;
4. the use of semantic technologies and deep metadata.

Many research projects exploring digital PIM focus on ways to improve the hierarchical filesystem that is so common to desktop computing, with studies investigating



everything from ways to apply "*piling*" techniques to the desktop (Mander et al., 1992) to exploring why it is so challenging for users to enter meta-data about their files (Kao et al., 2003). Some researchers, such as Gyllstrom (2009), suggest that the best way to develop PIM-tools is to relieve users' cognitive burden by implicitly inferring as much meta-data as possible, making PIM-tools "*activity aware*" — a lot more personalised, and less demanding in the process (Gyllstrom and Soules, 2008).

Bergman et al. (2013) explored users preferences for the use of folders as compared to the use of tagging for organising both email as well as document files on the computer; the study concluded that individuals strongly prefer folders over tags, suggesting tags are more useful when an individual is unfamiliar with the organisation scheme and is relying on the tags of another person to locate something in an unfamiliar structure. This is in line with research that explores user-subjective PIM, such as Bergman et al. (2003, 2009, 2012). The user-subjective perspective on PIM suggests that PIM-tools should acknowledge that the person who store a piece of information is the same person who retrieves it and allow them use subjective attributes to assist with future retrieval.

### 2.2.2.1 Summary

Explorations of digital PIM in the research domain primarily focus on addressing the needs of, or exploring, a particular PIM-tool, or developing an understanding of the PIM-tools that are used with a specific PIM-platform. Past studies, whilst they have branched out into exploring PIM as a cross-tool activity (e.g. Boardman, 2004), do little in the way of exploring PIM as a cross-platform activity.

The fact that PIM is a cross-platform activity is, if anything, incidental to the way that the majority of past research operates and presents itself. Studies such as Barreau and Nardi's (1995) influential work were conducted at a time prior to the extraordinarily widespread use of multiple platforms, while more recent studies focus on the activities occurring across one (Ducheneaut and Bellotti, 2001) — or multiple (Boardman, 2004) — tools within a single platform.

We are left with a generality of research that focuses upon classifying habits within a specific PIM-tool, on a specific platform (e.g. Abrams et al., 1998), or on the requirements of PIM-tools for a specific platform (e.g. Warren, 2013), or on improving the way hierarchical filesystems support document files (e.g. Cockburn and McKenzie, 2001), but little in the way of understanding and supporting how people work with multiple PIM-platforms to get things done.

The following key observations arising from the state of the digital PIM domain must be noted:

- the majority of past research focuses upon classifying the habits and practices of people practicing digital PIM;
- few studies explore the relationship between the digital and physical domains of PIM.
- there is little in the way of empirical studies into how PIM works when multiple platforms are involved.
- research is pushing towards suggesting that PIM-tools should rely more on both the context that the individual using it is operating in (Warren, 2013) and the user-subjective attributes which they may attribute to their information (Bergman et al., 2003).

### 2.2.3 Theory and PIM

Opinions differ on the objectives and nature of theory in HCI and related research (e.g. Nardi, 1996a; Kjeldskov and Graham, 2003; Rogers, 2004; Zimmerman et al., 2007; Cairns and Cox, 2008, amongst others). This researcher adopts the broad perspective of Rogers (2004): theory in HCI should describe and explain interactive phenomena, make predictions on the effect and impact of a design, and generate new routes for design. This perspective is well-supported amongst PIM research (e.g. Boardman, 2004; Nadeem, 2007; Henderson, 2009a).

Drawing from this perspective of theory, this section explores the theoretical work related to the premise of this research, over the following three sections:

- Section 2.2.3.1 discusses models and frameworks for PIM;
- Section 2.2.3.2 discusses classification schemes and categorisations related to PIM;
- Section 2.2.3.3 discusses other connected theory, including those from related domains such as information retrieval and HCI in a broader sense.

#### 2.2.3.1 Models and Frameworks

The definition of PIM used in this research was provided in Section 2.1. At the core of this definition lies Barreau's (1995) conceptual model of PIM activities: *acquisition*, *organisation*, *maintenance*, and *retrieval*. Though Barreau's (1995) model is a predetermined component of theory used by this research, it would be remiss of this researcher not to expound upon both this framework and the myriad others that exist to describe various facets of PIM.



Barreau's (1995) work sits in the category of descriptive theory for PIM, in that it describes something that occurs without attempting to predict user behaviour. Predictive theory, on the other hand, often describes user behaviour in a way that can be used to direct future design (Boardman, 2004). The remainder of this section, therefore, explores the following models and frameworks:

- Barreau (1995), which conceptualises PIM over four sub-activities: acquisition, organisation, maintenance, and retrieval;
- Lin et al. (2004), which defines the lifecycle of micronotes, small scrappy pieces of information;
- Boardman's (2004) extension of Barreau's (1995) model, suggesting that PIM takes place across multiple PIM-tools;
- Jones and Teevan's (2007) division of PIM into three types of activities: keeping activities, re-finding activities, and meta-level activities.

It is often lamented (e.g. Boardman and Sasse, 2004; Jones, 2012) that PIM theory, such as models and frameworks, is inaccessible to designers and is only of relevance to academia. It is the researcher's opinion that this is a matter for how such theory is applied.

**Barreau's (1995) Model** This model originates in a research project (Barreau, 1995) that explored how a group of knowledge workers organised, stored, and retrieved their electronic documents, with a view to determining requirements for PIM-tools and begin exploring how behaviours around electronic documents might differ from physical documents (Kwasnik, 1989). Barreau's (1995) defines four sub-activities, and treats PIM as a monolithic system centred on an hierarchical file system. Barreau's (1995) model, both modified and unmodified, is used extensively in a myriad of diverse PIM research projects (e.g. Barreau and Nardi, 1995; Keller et al., 1997; Bergman et al., 2003; Ravasio et al., 2004; Boardman, 2004; Jones et al., 2005; Jones and Teevan, 2007; Bernstein et al., 2008; Jones et al., 2012; Jones, 2012; Kim, 2013).

To Barreau (1995), PIM is *"an information system developed by, or created for, an individual in a work environment"*. The sub-activities of PIM in this model are:

- *acquisition* of information, including grouping or naming information;
- *organisation* of information, for example filing;
- *maintenance* of the collection of information, updating, archiving and deleting;



- *retrieval* of information, via search or browsing, driven by information needs.

[Barreau's \(1995\)](#) model, when considered to encompass more than just the activities of an individual within a hierarchical file system, largely represents the initial view of PIM taken up in this thesis. This work suggests that the computer, and its hierarchical file system, is just one PIM-platform coexisting with any number of other PIM-platforms in the work environment of an individual; each of these PIM-platforms may have run on a number of PIM-tools, software or otherwise, that each allows users to manage a collection in a particular technological format. The model, as used by this thesis, describes the activities performed by an individual within any particular PIM-platform and PIM-tool, or across many PIM-platforms.

[Lin et al.'s \(2004\) Micronote Lifecycle](#) This model describes the lifecycle of micronotes; micronotes, sometimes referred to as information scraps, are information items that fall outside of most PIM-tools ([Ispas et al., 2012](#)), such as small, hastily created, created within other piece of information ([Bernstein et al., 2008](#)), or captured in an ad-hoc way notes ([Bernstein et al., 2008](#); [Ispas et al., 2012](#)). The micronote lifecycle consists of the following stages:

- *record* in which information, micronotes in this case, is captured or created;
- *transfer*, in which micronotes are transferred to a more permanent form of information, and/or *refer*, in which micronotes are made use of;
- *completion, archiving, or disposal*, in which micronotes are disposed or archived.

[Lin et al.'s \(2004\)](#) lifecycle is useful, because it describes the stages of use for micronotes, which are a particular type of information that appears to be becoming increasingly prevalent ([Whittaker and Hirschberg, 2001](#); [Campbell and Maglio, 2003](#); [Sellen and Harper, 2003](#); [Lin et al., 2004](#); [Jones, 2012](#)). A range of past PIM research projects makes use of this lifecycle to support discussion and exploration of informal notetaking, micronotes and information scraps, and the ways in which people work with temporary information (e.g. [Dai et al., 2005](#); [Bernstein et al., 2008](#); [Brandl et al., 2010](#)). This thesis makes use of the lifecycle to explore the ways in which paper is used as part of a cross-platform PIM ecosystem.

[Boardman's \(2004\) Model](#) This model is an extension of [Barreau's \(1995\)](#) work; it suggests that the updating of information is not a facet of any PIM sub-activity as it relates to the content of information. [Boardman's \(2004\)](#) work considers PIM to be something that takes place on a computer across multiple PIM-tools, rather than within a single PIM-tool, the sub-activities of PIM are otherwise identical to [Barreau \(1995\)](#).

Boardman's (2004) model also conceives of PIM as a supporting activity, suggesting that there are two types of work activity: *production activities*, and *supporting activities*. Production activities are the actual work that an individual performs, such as preparing for a specific meeting, or writing a specific report. Supporting activities are the work performed in order to achieve the production activities, such as PIM and everything that it encompasses.

**Jones's (2012) Model** This model splits the sub-activities of PIM into three groups, each of which supports people's information needs. The groups —types of activities— are:

- *keeping activities* that relate to decisions made relating to an item of information regarding whether having it available for future needs is required;
- *refinding activities* that relate to presenting information needs;
- *meta-level activities* that relate to maintaining, organising, making sense of, and evaluating the usefulness and state of an individual's entire personal information collection.

Jones (2012), and other work, such as Jones and Teevan (2007), explores how there is a flow both from information to need, and need to information. In this model, the *keeping activities* relate to the flow from information to need, the *refinding activities* relate to the flow from need to information, and the *meta-level activities* relate to both flows. This model is designed to be more general than Barreau's (1995) and its extensions. Jones and Teevan's (2007) model is used by a range of PIM research as a way of exploring the ways people locate and keep information and reasons behind it (e.g. Houston and Harmon, 2007; Bergman et al., 2008; Indratmo and Vassileva, 2008; Hearst, 2009).

**Other Models and Frameworks** Other models and frameworks exist, such as Whittaker and Sidner's (1996), Ravasio et al.'s (2004), Finneran's (2008), and Kljun and Dix's (2010). Many of these are refinements or adaptations of the concepts from those discussed above; Finneran (2008), for example, builds on Jones and Teevan's (2007) "*keeping activities*" with facets from hoarding research (Frost and Hartl, 1996), such as emotional attachment to possessions, indecision, and emotional distress. Kljun and Dix's (2010) framework builds on Boardman's (2004), but suggests that there are no solid borders between PIM activities, and that PIM activities happen in an interchangeable fashion and can overlap. Ravasio et al.'s (2004) model suggests that organisation is the primary objective of PIM, whilst Whittaker and Sidner's (1996) focuses on the relationships between the *keeping*, *management*, and *exploitation* of information.



### 2.2.3.2 Classifications and Categorisations

As can be seen from the discussion of PIM thus far in this chapter, many of the outputs of PIM research and theory consist of classifications, categorisations, and descriptions of common behaviours, activities, and PIM styles. This section discusses a number of these classifications and categorisations.

For organisation strategies, [Malone \(1983\)](#) pioneering work categorised paper document strategies as *"neat"* and *"messy"*; [Mackay \(1988\)](#) categorised email strategies as *"prioritisers"*, *"archivers"*, *"requesters"*, and *"responders"*; ([Whittaker and Sidner, 1996](#)) categorised emailers as *"no filers"*, *"frequent filers"*, *"spring cleaners"*; [Bälter \(1997\)](#) categorised emailers as *"folderless cleaners"*, *"folderless spring cleaners"*, and *"spring cleaners"*; [Gwizdka \(2004\)](#) categorised emailers as *"cleaners"* and *"keepers"*; [Abrams et al. \(1998\)](#) categorised web bookmark strategies as *"no filer"*, *"creation time filer"*, *"end of session filer"*, and *"sporadic filer"*; and [Boardman and Sasse \(2004\)](#) categorised organising attitudes as *"pro-organising"* and *"organising neutral"*.

Other classifications describe the different types of information that can be managed in PIM; examples of these descriptive classifications ([Rogers, 2004](#)) include [Cole \(1982\)](#), who describes *"action information"*, *"personal work files"*, and *"archive information"*; [Barreau and Nardi \(1995\)](#), who describe *"ephemeral"*, *"working"*, and *"archived"* information; and [Gwizdka \(2000\)](#), who describes *"ephemeral"*, *"working"*, and *"retrospective"*. Few predictive classifications ([Rogers, 2004](#)) appear to exist; [Bälter's \(2000\)](#) work on keystroke level analysis of emails is an example of a predictive model of PIM, as it allows for various tasks — such as searching for an email, or filing an email — to have their time requirement estimated based on variables such as the number of emails and folders.

Another descriptive classification of PIM for a type of information is *"micronotes"* — or *"information scraps"*; micronotes are the notes that people make that do not necessarily fit into a formal organisation structure ([Lin et al., 2004](#)), they are typically brief in nature, and might be scrawled on the margins of other pieces of information, on the back of envelopes, or on sticky notes or similar ([Bernstein et al., 2008](#)). [Lin et al. \(2004\)](#) suggests that micronotes *"focus on present information and its future use"*, as compared to the intent of more formal notes, which might serve to remind individuals of that which has already been experienced ([Neisser and Hyman, 1999](#)). Micronotes are worthy of comment as they represent a type of information that most PIM-tools fail to effectively support, and a type of information that is often created on multiple PIM-platforms ([Lin et al., 2004](#); [Bernstein et al., 2008](#)).

[Jones \(2012\)](#) suggests a classification for people: *"information warriors"* and *"information worriers"*; the warriors treat the information, PIM-tools, and PIM-platforms as



strategic assets, whilst the worriers treat these things as cost centres — things that cost time and money to keep up with. Such classifications for the different ways in which people work can be useful aids to discussion; they allow researchers present their work using a *lingua franca*.

Recently, [Bergman \(2013\)](#) has reported on an exploratory study through which 15 variables for PIM were identified; these variables were found by comparing participant behaviours and identifying the extremes for each behaviour. Such variables could be used to characterise and account for the vast range of PIM behaviour in future research, and assist in transitioning PIM into rigorous quantitative studies in the future.

### 2.2.3.3 Other Related Theory

"Knowledge workers" are an oft-explored group of individuals for PIM; [Drucker \(1959\)](#) is the most common source for a definition of "knowledge worker". The key things that differentiate knowledge work, and knowledge workers, from other forms of work, and other types of workers, are:

- knowledge workers "*think for a living*" ([Davenport, 2005](#));
- non-routine problem solving, requiring creative, divergent, and convergent thinking ([Reinhardt et al., 2011](#));
- knowledge workers spend a large amount of their working time searching for information; [McDermott \(2005\)](#) suggests that they spend 38% of their time searching for information;
- knowledge workers have large amount of independence and autonomy in defining their own working habits and environment ([Cortada, 1998](#)).

Examples of knowledge workers, as far as the definition used for this thesis is concerned, include:

- doctors
- nurses
- lawyers
- teachers
- architectures
- software engineers

This list is far from exhaustive, however it serves its purposes to demonstrate the nature of the knowledge worker represented in this thesis. [Drucker's \(1959\)](#) definition of a knowledge worker as one who works with information, or develops and uses knowledge (from information) in the workplace ([Carleton, 2011](#)).

### 2.2.4 PIM Tools and Products

A vast range of past research has focused on the creation of new workspaces —PIM-tools —for personal information management, with the goal of replacing the currently dominant hierarchical systems. This thesis is largely unconcerned with such systems, as it seeks to support the way PIM is conducted in the real world —enhancing the *status quo*, rather than requiring changed work habits and activities. That said, it is worth providing an initial understanding of these "*revolutionary design*" ([Newman et al., 1995](#)) systems and tools in order to build context.

Many systems attempted to combine multiple styles of organisation; [Rekimoto's \(1999\)](#) TimeScope, for example, attempted to combine temporal and spatial information management, allowing users to navigate through the past versions of their digital documents in a spatial manner. Other systems, such as Lifestreams, worked solely with a temporal paradigm ([Fertig et al., 1996b](#)), or like Data Mountain ([Robertson et al., 1998](#)), and those inspired by it ([Cockburn and McKenzie, 2001](#)), went spatial and three-dimensional. Others still focused on a logical paradigm, such as [Gifford et al.'s \(1991\)](#) semantic file system, [Dourish et al.'s \(1999\)](#) Presto, or [Karger et al.'s \(2005\)](#) Haystack, unifying everything alongside powerful search tools. Other research projects have proposed digital systems that can provide a logical interface for paper documents, such as [Rao et al. \(1994\)](#); [Trigg et al. \(1999\)](#); [Bellotti and Smith \(2000\)](#). In the commercial domain, Apple's "Versions" capability in Mac OS X is a widely used example of temporal navigation ([Apple, Inc., 2013b](#)): allowing users to browse through the evolution of their files, or of an individual file, by time.

As PIM is practiced on more platforms, using more tools, and more software than ever before ([Jones, 2012](#)), office workers are increasingly being allowed —and in some cases encouraged —to bring their own devices ("BYOD") to work ([Thomson, 2012a](#); [Hayes and Kotwica, 2013](#)), resulting in even more PIM-platforms for them to operate with in the office. This also results in a very diverse ecosystem of software PIM-tools, with different individuals having vastly different preferences for which tools open their files and documents ([Jones, 2013](#)). This trend suggests solutions that enhance the *status quo*, rather than requiring changed work habits and activities are important; this idea is reinforced by suggestions from past research that it is challenging to get users to enter metadata about their information, as users are more interested in conducting



the work rather than managing their information ([Kao et al., 2003](#); [Jones, 2013](#)).

Whilst this thesis is primarily concerned with PIM in the research domain, PIM-tools from the commercial domain of PIM are also relevant, as they are used by people to get things done in the real-world. The remainder of this section surveys and discusses a number of products that have been developed and marketed in the commercial world of PIM-tools and PIM-platforms. Software PIM-tools are a booming product segment ([Semil Shah, 2013](#)).



**Figure 2.4:** Evernote, a popular software PIM-tool

Evernote, one of the most popular software PIM-tools, run on a wide variety of machines, including smartphones, tablets, smart-pens, and computers. Evernote — shown in promotional imagery in [Figure 2.4](#) — describes themselves as follows:

*"Our goal at Evernote is to help the world remember everything, communicate effectively and get things done. From saving thoughts and ideas to preserving experiences to working efficiently with others, Evernote's collection of apps make it easy to stay organized and productive."*

At the time of writing Evernote claims to have over 65 million users ([Swallow, 2013](#)). Evernote primarily serves as a searchable repository of text and images, designed to serve a single user; it is a PIM-tool in the most literal, straightforward sense of the term. Evernote is particularly noteworthy in a discussion of cross-platform PIM, as it claims to be designed to support work habits of this that use, and move between, multiple platforms on a regular basis ([Evernote, Inc., 2013a](#)):

*"Evernote makes it easy to remember things big and small from your everyday life using your computer, phone, tablet and the web."*



Other so called "*cloud services*", such as Dropbox, Skydrive, and Google Drive, offer relatively popular file-system synchronisation tools (Drago et al., 2012) that allow users to maintain a folder in their computer's hierarchy that is automatically made available to other platforms. This folder, however, is a separate and special location on their filesystem, and requires wholesale adoption and integration into users' use of their filesystem in order to use in an holistic manner (Drago et al., 2012; Casas et al., 2013).

Of course, other PIM-tools, such as the undying Microsoft Outlook, exist, and are popular, but the functionality is largely the same: outside of the research domain, PIM-tools do little more than provide repositories for a certain kind of information —sometimes email, sometimes document files, sometimes text and images. Commercial PIM-tools do not attempt to meaningfully address cross-platform PIM beyond providing a synchronisation mechanism for their own particular black box (Drago et al., 2012).

### 2.2.5 Related Domains

PIM has a number of closely related domains; these domains are not strongly tied to the research presented here, but an understanding and acknowledgement of them is useful. These domains were touched upon in Chapter 1. This section summarises a number of these related domains:

- information management;
- knowledge management;
- information retrieval;
- general information management;
- collaborative information management;
- personal document management.

*Information Management* (IM) relates to the management of information at an organisational level (Feather and Sturges, 2003). This is sometimes referred to as *knowledge management* (KM) when in the context of a very large institution (Wilson, 2002). IM and KM are similar to PIM in that they typically involve the acquisition, organisation, maintenance, and retrieval of information, but that is where the similarities end; PIM is concerned solely with an individual.

*Information Retrieval* (IR) involves the exploration of, primarily systems, for search, indexing, data recall, and general unstructured data (Baeza-Yates and Ribeiro-Neto,

1999). PIM can be considered to involve IR in its sub-activities of acquisition and retrieval (Boardman, 2004). This thesis is only concerned with IR insofar as IR is required as part of certain components of PIM; for example, the acquisition of an item of information for PIM may involve using a IR system, such as a website.

*General Information Management* involves a professional worker managing information for other people (Bergman et al., 2003). General information management, such as the work performed by a librarian, is outside the scope of PIM, as PIM is solely concerned with an individual.

*Collaborative Information Management* (CIM) involves a collection of information that is managed by multiple individuals, such as a share filing cabinet or multi-user cloud storage. CIM is home to numerous CIM-specific issues, such as the need for a shared vocabulary amongst individual users for use when naming or classifying information items (Berlin et al., 1993). As interesting as it can be, as it involves multiple people interacting with information, CIM is not relevant to the study of PIM in this research.

*Personal Document Management* (PDM) is very closely related to PIM, but focuses solely on the management of digital documents, typically on a single platform (Henderson, 2009a). PDM is, therefore, a sub-field of PIM; components of this thesis that revolve around the use of digital documents are related PDM, but to keep discussion straightforward, this thesis restricts itself to using PIM as an umbrella term for this discussion. Other components of this thesis, such as those that relate to paper documents, are not PDM; it could also be argued that the components of this thesis related to tablet computers are not PDM (Henderson, 2009a).

In summary, whilst it is important to acknowledge and have an understanding of these domains, they are not the focus of this research. This research is focused on PIM, and PIM is focused on the efforts of individual people to manage and work with the information directly under their control.

## 2.3 Tools for Research

This section surveys and discusses the various techniques, tools, instruments, and approaches to research design and construction utilised by related and similar research. Past studies of PIM have taken a variety of different approaches to their research, and exploring them presents myriad options for the present study.

At a high level, Carroll's (2000) approach to design-based research is strongly applicable here. Recommendations for future design — for improving a particular situation — are a potentially substantial theoretical output (Carroll, 2000; Rosson and Carroll, 2002). Employing design as a research method brings with it two implied objectives: understanding the specific "world" under study, and improving that world



through recommendations for design (Carroll, 2000; Rosson and Carroll, 2002). This perspective can be contrasted with the idea of design as a craft, or design as the object of research (Boardman, 2004; Diaper, 2006).

Some studies, such as Boardman's (2004), make formal use of the task-artefact cycle (Carroll et al., 1991; Carroll, 2000) — where the study of a task and its context gives way to the requirements for the design of an artefact to support that task which is then evaluated in the same context. This research draws inspiration from this cycle. Particularly, the researcher is enamoured with the idea that a given task (or group of tasks) sets the requirements for the design of artefacts to support that task. In turn, the use of the artefact creates new opportunities or constraints on the performance of the task which then lead to a revision of the task itself, and the cycle continues.

Essentially, the task-artefact cycle is the iterative process of mutually dependent development of both a task and artefacts to support that task (Carroll et al., 1991; Carroll, 2000; De Léon, 2003). Carroll et al. (1991) tends to be the canonical citation for the task-artefact cycle, but many other researchers describe it as well (Wilson et al., 1993; Sutcliffe, 2000). This thesis does not formally apply the task-artefact cycle, but draws inspiration from the idea of building an artefact to support a task, then evaluating the task and the artefact in the same context.

With this design-based approach in mind, the following four sections unravel as follows:

- Section 2.3.1 showcases the potential tools for data collection;
- Section 2.3.2 showcases the potential tools for data analysis;
- Section 2.3.3 explores the ways in which data can be presented and discussed;
- Section 2.3.4 discusses the methods by which PIM-tools can be evaluated.

### 2.3.1 Data Collection

A consistent set of data collection research methods and tools are used by those studying HCI- and PIM-related areas. This section summarises the most common methods and tools and discusses appropriate strategies for this research. This summary is presented over the following three sections:

- Section 2.3.1.1 lists overall research methods used by similar research projects;
- Section 2.3.1.2 discusses techniques borrowed, primarily, from industry;
- Section 2.3.1.3 lists data collection tools used by similar research projects.



### 2.3.1.1 Research Methods

This section discusses the most common overarching research methods typically used in PIM research; different research methods have different objectives, may involve the use of multiple tools, and may be naturalistic or controlled. The common research methods discussed here are:

- *case studies*
- *field studies*
- *action research*
- *laboratory studies*
- *environment-independent studies*

**Case Studies** Case studies are empirical investigations that use a variety of qualitative data-collection tools, without the use of statistical control, to investigate contemporary phenomenon in a natural setting (Benbasat, 1984; Wynekoop and Conger, 1992; Cheverst et al., 2001; Kjeldskov and Graham, 2003; Yin, 2008). A case study typically involves a small group, often from a single organisation, and the researcher sits separate from the phenomena and field under study (rather than embedded within it) (Yin, 2008).

Kjeldskov and Graham (2003) notes that case studies are a particularly useful means of gathering rich data regarding mobile devices in context. Case studies allow access to realistic, routine behaviour, and are well suited to provide a longer term perspective on participants PIM behaviour than, for example, a controlled study might allow (Kjeldskov and Graham, 2003; Yin, 2008).

**Field Studies** A field study is a qualitative, or quantitative study of a phenomena in its natural context (Wynekoop and Conger, 1992). Field studies originate in the sociological and anthropological disciplines, but are increasingly common in HCI-related domains. A field study in such a domain typically involves the researcher embedding themselves within the environment under study: observing, interviewing, and recording the phenomena under study in its normal context (Wynekoop and Conger, 1992; Kjeldskov and Graham, 2003).

Field studies that include quantitative data collection typically focus on the manipulation of a number of variables, while recording the influence of that manipulation. Regardless of the type of data collection employed, Kjeldskov and Graham (2003) notes that field studies typically generate a huge amount of rich, grounded

data in a relatively short amount of time; this suggests that field studies are useful to HCI-related research, as they can be used to understand current practice, or evaluate design in realistic real-world settings.

**Action Research** Action research involves the researcher inserting themselves into the area under investigation, both to directly assist as well as to explore and evaluate possibilities (Whyte, 1991). Action research involves a close relationship between the phenomenon under investigation and the researcher (Reason and Bradbury, 2001), and the outcomes of action research are challenging to generalise. Action research is often used in HCI-related research to supplement and support the results of case studies (Kjeldskov and Graham, 2003).

**Laboratory Studies** Laboratory studies are typically performed in a controlled environment — a figurative, though not necessarily literal "laboratory" — designed for the research (Kjeldskov and Graham, 2003). The use of the word laboratory refers to the controlled, artificial nature of the experiments. Laboratory studies are often, but do not have to be, based around quantitative measurements.

Laboratory studies are useful when the phenomenon under study can benefit from the manipulation of any number of variables before and during the data-collection. Laboratory studies are also, when conducted correctly, repeatable and highly generalisable (Silverman, 2013). In HCI-related research, laboratory studies are most often used for the evaluation of predetermined hypotheses.

**Environment-independent Studies** Environment-independent studies are such things as survey research, applied research, basic research, and so on (Kjeldskov and Graham, 2003). Survey research is discussed later on, in Section 2.3.1.3, but typically involves collection of data independent of the environment of the participants (Cheverst et al., 2001; Kjeldskov and Graham, 2003).

Applied research is typically used when the desired output of the research is somewhat known, which allows specific techniques to be applied in an attempt to elicit or confirm that outcome (Cheverst et al., 2001; Kjeldskov and Graham, 2003). Applied research is, therefore, very goal-oriented, and useful for research that requires something to be evaluated against an initial set of goals (Hoyle et al., 2002; Kjeldskov and Graham, 2003).

Basic research typically involves trial-and-error, application, exploration, and the eventual validation of new theories or solutions to problems (Kjeldskov and Graham, 2003). Basic research is typically time consuming, but is useful for the development of brand new theoretical frameworks.



### 2.3.1.2 Industry Methods

A number of research methods that are primarily used in the software engineering industry are also used, and useful, by, and for, other PIM researchers. The most prevalent method from this area is the practice of user-centred design (UCD). [Vredenburg et al. \(2002\)](#) defines UCD as the practice of:

*"the active involvement of users for a clear understanding of user and task requirements, iterative design and evaluation, and a multi-disciplinary approach"*

User-centred design (UCD) is a software development and user interface design practice that focuses on the needs, wants, practices, limitations, and activities of the end users of the product being designed ([Maguire, 2001](#); [Gulliksen et al., 2003](#)). UCD typically involves a range of data collection tools, and are typically structured over three phases:

1. gathering of requirements;
2. design and prototyping;
3. evaluation.

Related design practices include cooperative design, participatory design, and contextual design ([Greenbaum and Kyng, 1991](#)). Cooperative design, participatory design, and contextual design all suggest that the end user and the designer are on an equal footing ([Greenbaum and Kyng, 1991](#)). UCD-type approaches typically work on the assumption that a design must be based on an explicit understanding of the users, their environment, and the tasks they need to perform ([ISO, 1999](#)).

The core of UCD typically used in past research is the process in which the needs, wants, and limitations of the end users of something are given extensive attention as part of the exploration, development, and evaluation process ([Boardman, 2004](#)). This multi-stage process tries to optimise the output around how people actually work, or need to work; rather than proposing new "revolutionary" ([Newman et al., 1995](#)) solutions that require changes in behaviour, it seeks to enhance the *status quo* (see [Kao et al., 2003](#), for example).

### 2.3.1.3 Collection Tools

The vast majority of PIM studies use a similar set of core data collection tools ([Millen, 2000](#); [Lazar et al., 2010](#)). The most prevalent tools used throughout the research cited in earlier sections of this chapter, in no particular order, are:



- *questionnaires* —sometimes referred to as surveys, and distributed either in a paper-based format or via a website;
- *interviews* —both structured and unstructured and conducted in-person or via video conference, often recorded or transcribed;
- *diaries* —conducted most commonly through paper, but occasionally through a context-specific software tool.

Other tools, such as focus groups, or overarching tools that encompass more than one individual data collection method are also used. The most popular approaches can be equated with case study or field study methods: naturalistic, empirical enquiries, exploring small groups in a real-world context. Occasionally, more formal usability studies are performed in order to assess the usability or usefulness of a prototype. Data-collection tools commonly employed as part of user-centred design activities (UCD) are also found in past PIM studies (Boardman, 2001, e.g.).

Some past research projects recommend the use of automated data collection, where prototypes and products log their usage in a predefined format for later analysis (Hagen et al., 2005; Jones, 2012). The use of automatic data logging in the prototypes is strongly suggested by Jones's (2012), who reports that incidental data collection, as a by-product of the daily use of information and PIM-tools, can be a valuable source of data that can be leveraged to improve PIM.

Each of these tools —questionnaires, interviews, and diaries —are now discussed.

**Questionnaires** One of the most popular tools for research across a variety of disciplines (Lazar et al., 2010), questionnaires are particularly popular for the exploration of new problems (Babbie et al., 1990). Questionnaires are often used when a snapshot of data regarding the phenomenon under study is required, and are useful in facilitating a basic, or initial understanding of participants needs or experiences (Kjeldskov and Graham, 2003). Questionnaires are popular in PIM research, and HCI research generally, for a variety of notable reasons:

- they allow access to a significant number of participants with minimal time commitment required on their part (Gillham, 2000; Kjeldskov and Graham, 2003);
- large amounts of data can be gathered through a relatively small amount of effort from the researcher (Foddy, 1994; Kjeldskov and Graham, 2003);
- questionnaires facilitate a great understanding of phenomenon for building future theory upon (Foddy, 1994; Gillham, 2000; Kjeldskov and Graham, 2003);

- questionnaires excel at providing a snapshot of participants, useful for developing future studies (Gillham, 2000; Kjeldskov and Graham, 2003).

It must be noted that, whilst the majority of work uses the terms survey and questionnaire interchangeably, some researchers, such as Dillman (2000), suggest that a questionnaire *"is only well element of a well-done survey"*. Whilst it can be argued that the questionnaire is the list of questions by itself, and the survey is the holistic approach surrounding the instrument, including the analysis technique, distribution of the questionnaire, and such (Lazar et al., 2010), this research uses the term questionnaire.

**Interviews** Another of the most popular tools for research across a variety of disciplines (Lazar et al., 2010), interviews provide an extremely flexible research tool, capable of deeply examining real-world practices in natural settings (Drever, 1995). Semi-structured interviews are particularly prevalent in HCI- and PIM-related research (Whittaker and Sidner, 1996; Robson, 2002; Boardman, 2004; Kirk et al., 2006). Kirk et al.'s (2006) study of digital photo management, for example, explored the activities people perform with their digital photos in between capturing them and other activities, such as sharing using interviews to gain a deep understanding.

Interviews are particularly powerful due to their ability to collect deep, detailed information that would otherwise be challenging to capture. The ability of participants to reflect and consider what they are talking about often provides insight that would not be captured through other instruments, such as questionnaires (Lazar et al., 2010). The sheer amount of time that it takes to meaningfully interview a single participant and transcribe the data is a challenge; however, if the potentially unbounded discussions can be managed appropriately they present a compelling amount of flexibility (Robson, 2002; Lazar et al., 2010). Many studies combine interviews with other data collection techniques, as this helps determine the relationship between behaviours and perceptions (Miller and Crabtree, 1999).

A semi-structured interview consists of an open-ended collection of themes that are desired to be explored, allowing new ideas to be raised in the process of the interview, in reaction to the interviewee (Lazar et al., 2010). Semi-structured interviews allow for the effective, yet slightly contradictory, combination of great flexibility with rigidity as needed (Drever, 1995). Semi-structured interviews are useful for exploring real-world practice, due to their natural setting, flow, and flexibility.

The use of semi-structured interviews for HCI-related research is common (Robson, 2002), and they are also particularly prevalent, accepted, and strong methods for PIM research (Whittaker and Sidner, 1996; Boardman, 2004). The flexibility inherent to their semi-structured nature strengthens the ability to explore real-world



behaviours in a very natural setting. An extremely social method, semi-structured interviews are often employed early on in the process of designing a new system (Robson, 2002) as they allow for the close consideration and examination of people, and the situations in which they work (Barriball et al., 1994).

**Diaries** Diaries are a popular choice in HCI where self-reported data is desired: they have a high ecological value due to their in situ, real-world nature (Czerwinski et al., 2004; Lazar et al., 2010). Diary studies reported on from past research appear to have functioned most effectively when supplemented by participant interviews, allowing for the discussion, evolution, and triangulation of findings (Ericsson et al., 1990; Rieman, 1993; Czerwinski et al., 2004).

Diary studies are reported to be at their most effective when the participant is asked to keep a diary only for a week or two (Rieman, 1993; Lazar et al., 2010), a recommendation reinforced by the typical length of diary studies conducted in past PIM and HCI research (Dix, 2010).

### 2.3.2 Data Analysis

The qualitative aspects of the PIM research discussed in Section 2.2 illustrate a remarkable consistency in data analysis approach: the majority of past PIM studies employ an approach based, to varying extents, on Grounded Theory (or a variant) (e.g. Kwasnik, 1989; Abrams et al., 1998; Bederson, 2004; Bergman et al., 2009; Lazar et al., 2010; Bergman et al., 2013; Bergman, 2013). Grounded Theory, and the methods and variants surrounding it ("*Grounded Theory Methods*", or GTM) are used to generate a strong explanatory narrative from data, and excel at seeing the unseen and relating the unrelated (Boyatzis, 1998; Braun and Clarke, 2006). GTM are typically designed for an analysis that is deeply grounded in the data being investigated; they are not step-by-step procedures that can be applied to a set of data, but are methods that suggest approaches and tools that researchers might use to help make sense of data (Strauss, 1967; Charmaz, 2006; Muller and Kogan, 2010).

The most effective applications of GTM in past PIM research are those where the research was not attempting to prove a specific hypothesis, but were exploring a particular dataset or facet of PIM. This likely arises from the fundamentally inductive nature of GTM (as opposed to deductive) (Suddaby, 2006). Naumer and Fisher (2007) confirms that Strauss's (1967) constant comparative approach to GTM, and methods arising from it, are the most common analysis approaches to qualitative data for PIM research: "*coding from the data*".

GTM allows for a focus on aspects of interest, whilst still being grounded in the



data, and allowing for interpretive analysis of the data. GTM allow for the generation of strong explanatory discussion ("theory") from the data, capturing multiple perspectives, the unseen, and "*relating the unrelated*" (Boyatzis, 1998; Braun and Clarke, 2006). The inductive, grounded nature of the analysis deeply linked the codes and themes to the raw data (Lazar et al., 2010). It is important to note that GTM are by no means step-by-step procedures that are applied to the data, or to participants of a study: GTM are methods that suggest how researchers might think about, or approach data (Strauss, 1967; Muller and Kogan, 2010), they are methods that help researchers make sense of data (Charmaz, 2006). GTM are not designed, or suitable for, exploring a particular hypothesis, or attempting to prove particular statements (Suddaby, 2006). In this sense, GTM are very much inductive, rather than deductive, methods.

GTM approaches typically followed in HCI-related research follow a fairly similar research programme (Muller and Kogan, 2010): the domain and type of data that is to be collected is known, therefore following the transcription of the data, the codes, themes, and categories are identified iteratively, then the categories are set in relation to each other, and a detailed analysis of the conceptual structure of the data is produced. While this approach does not mesh with the original ideology of early grounded theory approaches, such as Strauss (1967), it typically is a strong fit with the aims HCI-related research as it allows for a deep, explanatory understanding of the raw data to be developed whilst still maintaining a specific initial focus — although typically not a hypothesis to test.

Glaser (1992) suggests that the output of the application of GTM should be a product of the analyses, rather than merely illustrating earlier theories or ideas. Typical components of a GTM approach are (Dick, 2005; Charmaz, 2006; Star, 2007; Corbin and Strauss, 2008):

1. *data familiarisation* — the notation of initial ideas during a review phase to ensure that the researcher had a strong familiarity with the data;
2. *open coding* — open coding involves identifying repeated words and phrases found in the data;
3. *axial coding* — axial coding involves grouping the open codes into categories;
4. *selective coding* — selective coding involves focusing on the most important codes, reviewing those that occur most frequently, or in contrasting patterns (Muller and Kogan, 2010).

Less formal thematic analysis techniques are also often used in HCI- and PIM-related research. Thematic analysis has been noted to be a highly flexible, accessible,

and useful approach for qualitative analysis (Boyatzis, 1998; Roulston, 2001; Braun and Clarke, 2006). Thematic analysis involves a similar approach to GTM, but is less suitable for detailed theory-building due to its lack of multiple levels of abstraction (Henwood and Pidgeon, 1992), but is often used as a *"discovery stage"* where it is sought to establish a basis for new research (Adams et al., 2008). Thematic analysis is useful for identifying patterns in participant experiences (Adams et al., 2008).

Examples of past HCI- and PIM-related studies that have applied methods such as GTM and thematic analysis include Akin et al. (1987); Mander et al. (1992); Barreau (1995); Barreau and Nardi (1995); Kaptelinin (1996); Boardman and Sasse (2004) and Bergman (2013). Such studies have successfully applied methods styled after, inspired by, or directly implementing GTM and thematic analysis — often without specifically naming the approaches as such. These studies have produced solid, grounded outputs that are products of the approach, rather than illustrating or confirming earlier hypotheses or ideas (Naumer and Fisher, 2007).

### 2.3.3 Discussing Data

Past research employs a vast range of techniques to present and discuss the data from which findings arose. This section explores the most prevalent ways in which data is discussed in other PIM research. This section is structured around the following two data presentation tools:

- Section 2.3.3.1 discusses the use of personas and archetypes for the presentation of participant experiences and requirements;
- Section 2.3.3.2 discusses the use of scenarios;
- Section 2.3.3.3 discusses the use of conceptual models and frameworks for the communication of phenomena.

#### 2.3.3.1 Personas and Archetypes

User archetypes, sometimes referred to as personas, are typically used to showcase participants in a study that share a similarities in the data (Pruitt and Grudin, 2003); archetypes are gestalt entities, and do not represent a single or specific individual who participated in a study (Cooper, Alan, 1999; Cooper, Alan and Reimann, Robert and Cronin, David, 2012), but exist to showcase common, or similar, goals, attitudes, and behaviours (Putnam et al., 2012). Archetypes are often prescribed as useful tools for deriving the needs for future design (Cooper, Alan and Reimann, Robert and Cronin, David, 2012; Moser et al., 2012).



Cooper, Alan (1999) defines a number of facets of archetypes, suggesting that in order for them to be effective they should embody all or most of the following:

- archetypes are grounded in the data;
- archetypes express motivations and goals;
- archetypes encapsulate a specific set of usage patterns and needs;
- archetypes are presented as specific individuals that each represent a class of people, not a particular real person.

Archetypes are a common element of commercial product design, as they substitute fairly abstract, elastic, or contradictory needs with a variety of vibrant, specific personas (Sinha, 2003). While, as Pruitt and Grudin (2003) observes, archetypes are, first and foremost, intended to aid design, they do complement and amplify the effectiveness of qualitative (and quantitative) methodologies (Lazar et al., 2010).

A vast number of past studies of PIM utilise archetypes in the discussions of results. Henderson's (2009b) study of personal document management strategy, for example, uses personas as a way to present the different strategies encountered during the research, and notes that the personas serve as tools to guide user interface development in the future and do not serve as pigeon-holes in which all individuals can be neatly inserted. Kelly and Teevan (2007) asserts that archetypes are an effective method for PIM-tool development and evaluation, as they effectively convey a set of goals, tasks, and specific activity scenarios which can be used to both develop and then evaluate future PIM-tools.

### 2.3.3.2 Scenarios

Scenarios, sometimes referred to as user stories, are narratives — often only a sentence long — that describe how a user might use a system (Alexander and Beus-Dukic, 2009). Scenarios allow for the encapsulation and representation of goals, and describe how a system might be used (Alexander and Beus-Dukic, 2009).

Scenarios are useful for defining the desired behaviour of a piece of software, such that it can be evaluated against them in the future (Alexander and Beus-Dukic, 2009). Scenarios are used widely in HCI-related and PIM-related research (Jones and Teevan, 2007), and rely on the reader of the scenario being able to apply it to their own context to be effective (Lazar et al., 2010).



### 2.3.3.3 Conceptual Models and Frameworks

During the review of theory presented in [Section 2.2.3](#), a number of conceptual models — often called frameworks ([Bickman and Rog, 2009](#)) — were discussed. A conceptual model describes something in order to allow for it to be better understood and communicated ([Loucopoulos and Zicari, 1992](#); [Gemino and Wand, 2004](#)). A conceptual model is an effective means for codifying understanding of a specific phenomena, area, or domain. [Kung and Soelvberg \(1986\)](#) ascribes four fundamental objectives to a well designed conceptual model:

1. to enhance understanding of the system being represented;
2. to enable efficient communication of system details;
3. to enable those designing for the system;
4. to enable collaboration by allowing for future expansion of the description of the system.

Whilst this definition comes, primarily, from the domain of formal systems development ([Kung and Soelvberg, 1986](#)), it is suitable for understanding the requirements of a conceptual model designed for better understanding an area of research such as PIM ([Loucopoulos and Zicari, 1992](#); [Gemino and Wand, 2004](#)).

As with archetypes, a vast number of past studies and discussions of PIM, such as [Barreau \(1995\)](#); [Boardman \(2004\)](#); [Lin et al. \(2004\)](#); [Ravasio et al. \(2004\)](#) and [Jones and Teevan \(2007\)](#), utilise conceptual models to present their data. These studies either evolve past models and frameworks to describe the results of their study or discussion, or create and present new frameworks to showcase activities or otherwise unstudied facets of PIM.

### 2.3.4 Evaluating PIM-tools

Whilst the evaluation of PIM-tools may share much with the evaluation of tools in HCI research broadly, many researchers have observed that there are a number of unique facets that must be considered ([Henderson, 2009a](#); [Jones, 2012](#)). [Kelly and Teevan \(2007\)](#) suggests that the most prominent issues surrounding the evaluation of PIM-tools are:

1. lack of realistic PIM situations arising from the use of genuine personal information;
2. unpredictable and unspecific timing of PIM, conducted in a variety of contexts;

3. the investment users have in existing tools, routines, and strategies leading to disruption when something new is introduced.

A number of researchers suggest that the ISO 9241 "*core concepts of usability*" can be used as a framework through which the effectiveness of PIM-tools can be discussed and determined (Jones and Teevan, 2007; Maguire, 2013). Jones and Teevan (2007) suggests that ISO 9241, which is a standard measure of usability for software engineering, is relevant to PIM-tool evaluation because it is generally accepted that a good PIM-tool should be usable. In discussing the use of standard usability measures to support PIM-tool evaluation, Jones and Teevan (2007) discusses *effectiveness*, *efficiency*, *satisfaction*, *usefulness*, *ease of use*, and *ease of learning*. Other, less codified and possibly more subjective measures suggested by Jones and Teevan (2007) are *performance*, *adoption* and *use*, and *flow*.

*Effectiveness*, *efficiency*, *satisfaction*, and *flow* appear to be the most suitable facets of PIM-tools for evaluation (Jones and Teevan, 2007; Kelly and Teevan, 2007). *Effectiveness* and *efficiency* can be explored by determining whether the participants were able to accomplish the tasks that the tool was designed to support successfully, how they felt about their work in doing so, and how long things took compared to doing so without the tool (Sun and Kantor, 2006; Kelly and Teevan, 2007). This is most effective when PIM-tools are constructed with a number of usage scenarios in mind, such that the effectiveness and efficiency with respect to these scenarios can be discussed.

*Satisfaction* when using the PIM-tools prototypes can be determined by discussing whether they felt their needs were met by PIM-tools with participants, and how they feel with regards to being able to concentrate on important aspects of their work instead of being distracted by the mundane aspects of PIM (Czerwinski et al., 2001; Kelly and Teevan, 2007). By discussing how much time they felt they wasted, both with and without specific PIM-tools, a reasonable conception of participants' *flow* is also able to be gained (Csikszentmihalyi, 1997; Bederson, 2004; Kelly and Teevan, 2007).

Performance, as well as adoption and use, are fairly standard utilities for measuring the effectiveness of tools (Jones and Teevan, 2007), and flow is a common facet of psychology-related studies. Csikszentmihalyi's (1997) work in psychology suggests that are five characteristics of the experience of flow: challenge and require skill, concentrate and avoid interruption, maintain control, speed, feedback, and transformation of time. Flow is a possible utility for evaluating PIM-tools (Bederson, 2004; Jones and Teevan, 2007); being in flow means that people are able to focus on important tasks, and spend less time distracted or attending to mundane tasks (Csikszentmihalyi, 1997, 2000). These facets of flow generally align to the requirements of a good PIM-tool (Jones and Teevan, 2007; Jones, 2012).



Every single piece of past PIM research suggests that PIM-tools are extremely challenging to evaluate and explore, largely due to the highly subjective nature of PIM (Jones, 2012). Because of this, users express themselves in unique and inconsistent ways when discussing their habits, which requires a great deal of coding and recoding during analysis in order to normalise the ability to present and discuss their experiences (Boardman, 2004; Jones, 2012).

One particular suggestion of merit, raised by Van Kleek (2011), is that simple prototype PIM-tools, when built for research, are most useful than more complex ones as they afford a simple, quicker mastery. If an individual who is evaluating a PIM-tool can master that PIM-tool swiftly, they are more likely to devise ways to use it effectively and efficiently than if the tool were more complex. In general, as well, people tend to prefer simple tools over more complex ones when using them to manage information of any kind (Jones and Teevan, 2007; Bernstein et al., 2008; Van Kleek, 2011).

Some researchers, such as Whittaker et al. (2000), suggest that effective evaluation of tools depends on the creation of a number of "reference tasks" for HCI, pointing out that by standardising the tasks used for sub-areas — such as PIM — more effective evaluations, and re-use of techniques and data between disparate studies can be achieved. PIM research sorely lacks reference tasks (Jones and Teevan, 2007; Jones, 2012, 2013).

Many PIM-tools and prototypes are evaluated, at the outset, through industry standard software engineering tests (Pressman and Ince, 1992), as a way of improving the reliability and stability of the tools. Bringing methods from software engineering and product development, such as this, may also be a minor way to begin to address the research-practice gap (Sutcliffe, 2000; Rogers, 2004; Kljun et al., 2013).

## 2.4 Critical Analysis of Past Work

This section draws together the key components of the past work discussed in this review of research context, concluding with a number of salient observations related to the premise of this research that was presented in Chapter 1. The remainder of this discussion section is structured as follows:

- Section 2.4.1 identifies the most prominent trends in both the research and commercial domains of PIM;
- Section 2.4.2 explores the gaps and omissions identified in past work in the research domain;
- Section 2.4.3 summarises the critical analysis.



### 2.4.1 Trends

A number of ongoing trends can be identified in the design and development of PIM-tools and PIM-platforms, as well as in PIM research directions. The biggest trends identified in this review of the research context were:

- an emphasis on nothing more than organisation and search in the design of PIM-tools is common;
- an initial understanding of "activity aware" PIM-tools is beginning to appear in the literature (e.g. [Gonçalves and Jorge, 2008](#); [Gyllstrom, 2009](#)), but is underexplored;
- the definitions of context and contextualisation in PIM and PIM-tool research have a very limited scope;
- existing PIM-tools lack support for context;
- existing PIM-tools are not simple, and are typically seeking to be "revolutionary design" ([Newman et al., 1995](#)), rather than incremental improvements to the *status quo*;
- little exploration has been conducted of cross-platform PIM, and the reasons and means by which people conduct PIM across multiple platforms;
- very little from the research domain of PIM makes its way to the commercial domain of PIM ([Kljun et al., 2013](#)) —there is a research-practice gap ([Sutcliffe, 2000](#); [Rogers, 2004](#));
- the concept of the paperless office ([Sellen and Harper, 2003](#)) is alive and well in the research domain ([Liu and Stork, 2000](#); [Vital and Renfew, 2010](#); [Goldman, 2013](#)), but has not eventuated in the real world in any meaningful way ([Jones, 2012, 2013](#)).

### 2.4.2 Gaps and Omissions

As was introduced in [Section 1.2](#) and discussed in [Section 2.1](#), the overarching and initial premise of this research was that *there is insufficient research exploring modern cross-platform personal information management (PIM), as performed by knowledge workers*. The context of this premise, as surveyed in this chapter, through the lens of the trends noted above, led to the development of a number of focal observations on the state of the field and the research premise:

1. there was a lack of research into the practice of cross-platform PIM;
2. there was a lack of research into the use of tablet technology for PIM;
3. specifically, little is known about the relationships between different PIM-platforms, and the differing ways in which they are used;
4. the research-practice gap ([Sutcliffe, 2000](#); [Rogers, 2004](#); [Kljun et al., 2013](#)), where HCI research outputs can be irrelevant to the real-world needs, is ominously lurking throughout PIM research

### 2.4.3 Summary

The review of research context presented throughout this chapter made it clear that past research is not only lacking in relation to the practice of cross-platform PIM, but also in relation to understanding the use of tablet technology for PIM. The research-practice gap, highlighted by [Rogers \(2004\)](#), is also alive and well in much of the past PIM research ([Kljun et al., 2013](#)), but more worrying still is the lack of exploration into the ways and means by which multiple platforms are used for PIM.

This lack of exploration appears to exist at all levels of past research —from the development of systems, right through to the development of theory.

## 2.5 Research Premise and Approach

This section reviews the research premise and approach, including the changes made to the objectives, scope, and agenda based on the content explored as part of the review of research context. The overarching and initial premise of this research is *that there is insufficient research exploring modern cross-platform personal information management (PIM), as performed by knowledge workers*. This section is structured as follows:

- [Section 2.5.1](#) presents the objectives of the research that arose from the overall research premise;
- [Section 2.5.2](#) presents the scope of the research;
- [Section 2.5.3](#) summarises the agenda and methodological approach.

### 2.5.1 Objectives

The premise, together with the observations reported in [Section 2.4.2](#), allowed for the development of three high-level objectives and a number of considered scope constraints for the research. The objectives developed, derived from the premise, were:

1. *to develop an understanding of cross-platform PIM, and PIM practices involving modern tablet technology* —the research sought to build an understanding of modern cross-platform PIM, through the lens of the tablet platform. The research sought to determine how tablets were used for PIM, the challenges faced by users of tablets for PIM, and the ecosystem of PIM-tools and PIM-platforms that the tablet is used in;
2. *to propose and evaluate an empirically-grounded model of cross-platform PIM* —the research sought to provide a conceptual model, and means for discussion of cross-platform PIM, which could be utilised to describe and explain future empirical observations and PIM-tool evaluations. It was anticipated that tablet technology would be used as the exemplar for the model;
3. *to propose, implement, and evaluate a number of prototype software PIM-tools that address typical cross-platform PIM challenges* —the research sought to develop a number of prototype software PIM-tools that would directly address one or more of the challenges identified through the study.

### 2.5.2 Scope

The researcher felt that it was important to appropriately constrain the scope of the research from the outset. Therefore, the scope of the research was initially constrained as follows:

1. *To focus on the activities of knowledge workers in their workplace* — A focus on knowledge workers, skilled workers who effectively turn information into knowledge, meant that there was a high likelihood that participants would require effective PIM in order to accomplish their jobs. It was felt that this would facilitate a more productive discussion of PIM with participants.
2. *To focus on cross-platform PIM through the lens of tablet computers* —To focus on cross-platform PIM without a specific platform as a lens was deemed too large in scope, and the tablet computer presented as a highly relevant, little studied (as compared to, for example, smartphones) lens with which the researcher had significant experience.
3. *To focus on the high-level activities of cross-platform PIM* —A focus on the high-level activities of cross-platform PIM, rather than the low-level minutia of specific PIM-tools.



### 2.5.3 Agenda

Methodologies used for PIM research —and indeed HCI research in general —are many and varied (Rogers, 2004; Lazar et al., 2010). The challenge of identifying the most appropriate techniques for any one research project is further exacerbated by the interdisciplinary nature of, again, both PIM and HCI (Rogers, 2004; Lazar et al., 2010; Jones, 2012).

The approach for the research reported on in the remainder of this thesis was inspired by user-centred design (UCD) methodologies. Specifically, inspiration was drawn from the following stages (Harrison et al., 2010):

1. *Gathering of requirements* —the exploratory study reported on in this chapter constitutes a requirements gathering phase, empirically grounding the later parts.
2. *Design and implementation* —the design work and prototypes reported on in the following chapter, Chapter 5, is motivated by the results of the exploratory study.
3. *Evaluation* —a core, but not singular, component of the field study reported on in Chapter 6 is the evaluation of the prototypes.

It is important to note that the overall research project is a not traditional or strict (e.g. Righi and James, 2010; Ekşioğlu et al., 2011) UCD-study, but it does utilise many of the methodologies and techniques present in such a study.

The agenda for the research was previously introduced in Section 1.3.2. The three phases of the research, following the review of context, were as follows.

#### 2.5.3.1 Phase 1: Pilot Study

The first phase of the research was a pilot study designed to provide an empirical basis upon which the first and second objectives of the research could begin to be addressed.

The pilot study had two components:

1. An online questionnaire, designed to identify the PIM-platforms and PIM-tools most commonly used by knowledge workers alongside tablets, and provide the first pieces of information for identifying the most prevalent challenges of cross-platform PIM.
2. A series of semi-structured interviews, designed to explore the identified PIM-platforms, PIM-tools, and challenges in more detail.

Analysis was conducted through multiple iterations of coding and theming using straightforward thematic analysis technique.

The core objectives of the pilot study were:

1. To begin to understand the context in which tablets are used for the purposes of PIM.
2. To identify the most prevalent PIM-platforms and PIM-tools used alongside tablets for PIM.
3. To identify the most significant challenges of cross-platform PIM, through the lens of tablet use.

The use of a pilot study for HCI research is common, as pilot studies assist in the construction of a foundation for research projects. A pilot study conducts a relatively simple initial line of enquiry alongside a straightforward inductive analysis. The form of pilot study chosen for use in this research project is inspired by those used in sociological disciplines ([Sears and Jacko, 2007](#); [Holborn et al., 2009](#)). Pilot studies were discussed earlier in this chapter in [Section 2.3](#).

#### **2.5.3.2 Phase 2: Exploratory Study and Prototypes**

The second phase of the research was an exploratory study, followed by the development of a number of software PIM-tool prototypes. The exploratory study was designed to further build the empirical basis necessary for addressing the first and second objectives of the research, whilst the prototyping was designed to begin addressing the third objective using the findings developed by this point.

The exploratory study had two components:

1. An online questionnaire, designed to dive deeper into exploring the facets tablet usage for PIM as reported by participants of Phase 1.
2. A second series of semi-structured interviews focused on gaining a deeper understanding of the particular problems of tablet-centric cross-platform PIM identified by participants of Phase 1.

Analysis was conducted using a multi-step iterative approach based on grounded theory methods ([Suddaby, 2006](#)). Following the analysis, the design and prototype construction was conducted.

The core objectives of the exploratory study were as follows:

1. To focus on, and further explore, the facets and challenges of cross-platform PIM involving tablets that were identified in the pilot study.



2. To build the empirical groundwork necessary to begin making recommendations for the construction of prototype software PIM-tools.
3. To provide the basis for an initial exploration of a conceptual model of cross-platform PIM, using tablets as an exemplar platform.

An exploratory study was used for the first part of the second phase of the research in order to deeply explore the use of tablet technology in cross-platform PIM (Uma and Bougie, 2003; Babbie, 2012). As with pilot studies, exploratory studies are frequently used for HCI research (Birnholtz et al., 2007; Babbie, 2012) due to their powerful inductive approach (Armstrong, 1970). Exploratory studies were discussed earlier in this chapter in Section 2.3.

The core objectives of the prototype design and construction were as follows:

1. To further explore one, or more, of the challenges that individuals practising cross-platform PIM involving a tablet face.
2. To develop a software PIM-tool prototype that allows for the exploration, and a deeper understanding of, cross-platform PIM and tablet technology.
3. To make initial recommendations regarding the evaluation of PIM-tools.

Prototype design and construction is also a commonly utilised, and discussed, element of HCI research (Wania et al., 2006; Zimmerman et al., 2007; Mankoff et al., 2013).

### 2.5.3.3 Phase 3: Case Study

The third phase of the research was a case study of a small group of knowledge workers designed to solidify and finalise the observations and recommendations in support of all three thesis objectives.

The case study was composed of a number of semi-structured interviews and diary studies. Participants further discussed the challenges of cross-platform PIM that they faced, utilised the prototypes developed, reported their experiences, and provided further data on their conduct of PIM through log data.

Analysis was conducted using the same approach, based on grounded theory methods, as was used for the exploratory study (Suddaby, 2006).

The core objectives of the case study were:

1. To build and expand on the exploration of the facets and challenges of cross-platform PIM, and the use of tablets, that were identified in the pilot and exploratory studies.



2. To evaluate and explore the software PIM-tool prototypes.
3. To further build upon the conceptual model of cross-platform PIM, using tablets as an exemplar platform.

A case study was used for the third and final phase of the research as it allowed for an uncomplicated approach to the evaluation of the data collected thus far, prototypes, and further general data on specific facets and challenges of PIM to be collected. The specific form of case study implemented here is described by [Kjeldskov and Graham \(2003\)](#) and [Yin \(2008\)](#). The reasons behind the choice of a case study are further discussed in [Chapter 6](#).

A number of theoretical components identified in the research domain by past studies of PIM are utilised throughout the work presented in this these. Primarily, [Barreau's \(1995\)](#) model of PIM, dividing it into the four sub-activities of acquisition, organisation, maintenance, and retrieval, will be built upon in defining a new model for understanding and exploring cross-platform PIM. [Barreau's \(1995\)](#) model was selected as it succinctly described PIM, and was a common feature of PIM research.

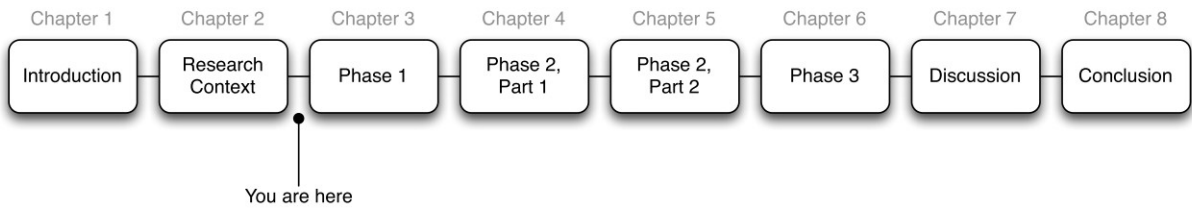
## 2.6 Conclusions

The review of research context presented in this chapter made a number of important revelations regarding the state of PIM research; in addition to identifying a number of trends in past research, as well as pertinent research gaps, the review resulted in the development of a number of specific objectives for this research, as well as focusing its scope and agenda.

Ironically, PIM has likely always been a highly cross-platform, but past research neglects this. The work presented in this thesis sits at an intersection of theory development and PIM-tool systems design, and seeks to provide the basis for both future product development as well as research.



[Chapter 3](#), following, presents the first phase of the research, a pilot study designed to determine the context and role of modern tablet technology in knowledge workers' PIM.







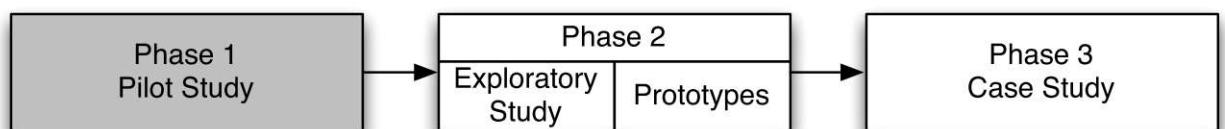
*A pilot study is undertaken before  
the real work.*

—Anonymous

# 3

## Phase 1: Pilot Study

**T**HIS chapter reports on the pilot study that was conducted in order to establish an empirical basis upon which the research could be built. The overarching objective of the pilot study was to provide an initial understanding of the context in which tablets are used for PIM, identifying the PIM-platforms and tools used alongside tablets, and —with a focus on tablets —identify the most prevalent challenges of cross-platform PIM. The pilot study focused on knowledge workers in an office environment and was the first phase of three, as shown in [Figure 3.1](#).



**Figure 3.1:** *Phase 1: Pilot Study*

### 3.1 Introduction

Inspired by sociological pilot studies ([Holborn et al., 2009](#)), this first phase of the project was designed to build an empirically grounded basis for the research and was driven from a need to better understand real-world cross-platform PIM as it stands today, a significant gap that was identified through the literature review.

Specifically, this study sought to identify, and provide an initial understanding of, the most prevalent PIM-platforms, and PIM-tools, used by knowledge workers

practicing PIM. This understanding would allow the remaining phases of the research project to better focus on the objective of building an understanding of the tablet's role in real-world PIM.

Whilst this phase of the project was intended to provide a background to the nature of PIM occurring with, and around, tablet technology, the use of tablet technology was not the only focus. The context in which tablets are used, particularly with reference to PIM-tools used, and other PIM-platforms used alongside, was the focus. Tablets were merely a pre-defined PIM-platform acknowledged as important to the study. This study also sought to validate the decision to focus on tablet technology as the nexus of discussion and identify the problems surrounding its use in cross-platform PIM.

### 3.1.1 Chapter Structure

The presentation and discussion of the pilot study is conducted over the following sections:

- [Section 3.2](#) provides an overview of the approach taken for the pilot study and the objectives behind it.
- [Section 3.3](#) reports the first component of the pilot study, an online questionnaire. The design of the questionnaire, including choice of methodology, participants, and data analysis are presented.
- [Section 3.4](#) reports on a number of initial findings, derived from the results of the online questionnaire. These initial findings are necessary for comprehending the sections following it.
- [Section 3.5](#) reports on the second component of the pilot study, a series of semi-structured interviews. The design of the interview procedure, including choice of methodology, participants, data analysis, and initial results are presented.
- [Section 3.6](#) provides an overview, followed by a detailed discussion, of the findings of the pilot study before concluding the chapter with reflections on the methodology and approach used, and a summary discussion of the main findings;
- [Section 3.7](#) summarises the work reported on the chapter.

## 3.2 Approach

The first phase was a pilot study for the overall research project. Pilot studies are often used in human-computer interaction (HCI) and HCI-related research and provide a foundation for larger research projects through an initial, relatively simple line of enquiry with clear analysis. They are a technique originally borrowed, in this form, from sociological disciplines, and are useful for empirically grounding, and confirming, the focus of a research project (Sears and Jacko, 2007; Holborn et al., 2009).

Whilst the pilot study was primarily designed to provide an understanding of the context in which tablets sit, it also allows for a better understanding of cross-platform PIM as it stands today. The review of past research that was presented in Chapter 2 identified this lack of understanding, and the lack of understanding of the role of the tablet as significant gaps.

The remainder of the section reviewing the approach is structured as follows:

- Section 3.2.1 discusses the specific objectives of the pilot study;
- Section 3.2.2 lists the methods used;
- Section 3.2.3 notes ethical considerations;
- Section 3.2.4 summarises the contributions to the research made by this phase.

### 3.2.1 Objectives

The pilot study was designed to begin to provide the empirical basis on which the first and second objectives of the research — presented in Section 1.2.1 — could begin to be addressed. This would be done by first identifying the PIM-platforms that tablets are most commonly used alongside, and the PIM-tools used on and with tablets. Broadly, this would also update our understanding of real-world PIM. Parallel with this, the pilot study sought to validate the research focus by confirming that tablets have a central role in many knowledge workers' PIM and identifying the most significant challenges in their use.

Specifically, the core objectives of this initial pilot study of cross-platform PIM were:

1. *to begin to understand the context in which tablets are used for PIM* — the study would illuminate the context and ways in which tablets are used for PIM by exploring their challenges and methods of use;

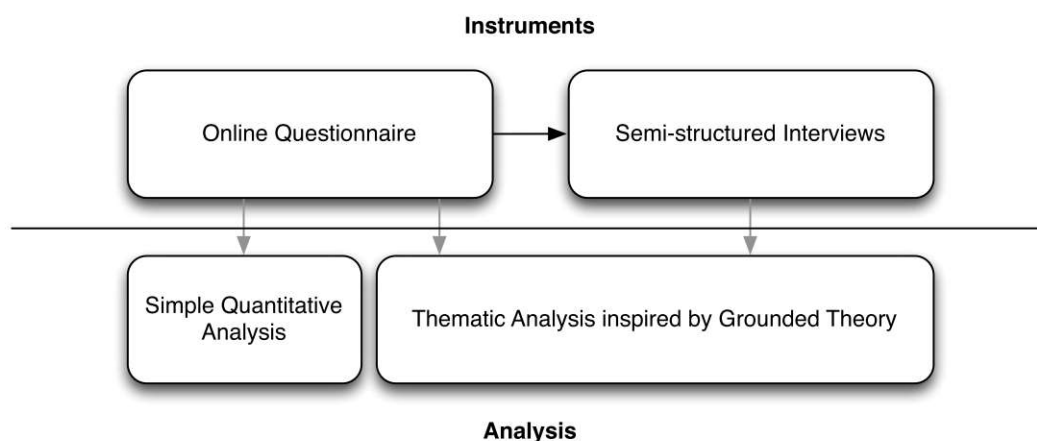


2. *to identify the most prevalent PIM-platforms and PIM-tools used alongside tablets for PIM* —in illuminating the context of the tablet in PIM, the study sought to identify the most prevalent PIM-platforms used alongside tablets, and the most common PIM-tools used in a cross-platform PIM environment.
3. *to identify the most significant challenges of cross-platform PIM, through the lens of tablet use* —the study would characterise and identify the most significant and common challenges faced by those conducting cross-platform PIM, using the tablet as a lens for discussion.

The objectives of the pilot study serve the objectives of the thesis by providing the scope constraint in the form of platforms to focus on, an initial understanding of the nature and challenges inherent to cross-platform PIM, and an initial understanding of the role of the tablet in cross-platform PIM.

### 3.2.2 Method

To address these objectives, the pilot study made use of two data collection tools: an online questionnaire and semi-structured interviews. These two instruments were used sequentially, with the results of the online questionnaire driving the conduct and design of the semi-structured interviews. As was discussed in [Section 2.3.1](#), online questionnaires and interviews, particularly semi-structured interviews, are respected and widely used instruments for data collection in similar research ([Kjeldskov and Graham, 2003](#)).



**Figure 3.2:** *The instruments and analysis techniques used in the pilot study*

Alongside a simple quantitative analysis of certain aspects of the questionnaire, analysis was primarily conducted using a thematic technique. The thematic analysis approach used for this phase is rooted in the techniques used for grounded theory

(Braun and Clarke, 2006). It is suited to analysis of early components of work without requiring a commitment by the researcher to the full gamut of GTM and its theoretical commitments, implied or otherwise (Braun and Clarke, 2006). Data analysis techniques for PIM research were previously discussed in Section 2.3.1. A visual overview of the data collection and analysis methods used for the pilot study is provided in Figure 3.2.

Following on from the observations regarding user-centred design (UCD) methodologies in Chapter 2, this chapter reports on the first part of what is, essentially, an implementation of a UCD methodology. Seen as a UCD-inspired methodology (Harrison et al., 2010), the stages employed are:

1. *Gathering of requirements* — the pilot study reported on in this chapter constitutes a requirements gathering phase, empirically grounding the later parts;
2. *Design and implementation* — the design work and prototypes reported on in the following chapter, Chapter 5, is motivated partially by the results of this pilot study;
3. *Evaluation* — a core, but not singular, component of the case study reported on in Chapter 6 is the evaluation of the prototypes.

It is important to note that this study is not a UCD-study, but it does use many of the methodologies and techniques present in such a study.

### 3.2.3 Ethics

The study reported on in this chapter was approved as a Minimal Risk Study (H10260) by the Tasmanian Human Research Ethics Committee. Precautions around data handling, procedure and analysis were taken. This was due to the potentially private and sensitive nature of participants' personal information. Precautions taken included:

- participants were not required, at any time, to discuss or show — even in passing — an item of personal information that they could not, or did not feel comfortable involving in the study;
- participants were free, at any time prior to the collection of data from them being completed, to withdraw completely from the study;
- participants were comprehensively informed that no judgements were being made by the researcher upon their organisational skill (or lack of).



### 3.2.4 Contributions

This chapter makes the following contributions to the research presented in the thesis:

1. *the identification and discussion of the PIM-platforms and PIM-tools most commonly used alongside tablets for PIM by tablet-using knowledge workers* — in line with the objectives of the thesis, the identification of the most prevalent PIM-platforms and PIM-tools to tablet-related cross-platform PIM constituted a significant contribution to the progress of the research;
2. *improved understanding of PIM behaviour across the three PIM-platforms identified: tablet, office computer, printed paper documents* — the data from this pilot study is used to build an initial picture of the nature of cross-platform PIM involving tablets, using Barreau's (1995) PIM model discussed in Chapter 2, for each of the PIM-platforms chosen as foundation of this research. This is reported in Section 3.6.2;
3. *the identification of the most prevalent challenges involving tablets as a PIM-platform, with a focus on cross-platform PIM* — the findings reported on in Section 3.6.2 suggest the three most prevalent challenges involving the tablet as a PIM-platform. These challenges are largely cross-platform related, and concern transferring information between PIM-platforms, maintaining context with information across PIM-platforms, and maintaining organisation with information in software PIM-tools.
4. *the identification of micronotes, and the use of paper, as a behaviour affected by tablet use* — the findings reported in Section 3.4.3 and Section 3.6.6 indicate that participants behaviour with respect to micronotes, a particular kind of information, and the use of paper, may be altered significantly in unexpected ways through their use of tablets for PIM.
5. *initial insight into the design needs of software PIM-tools for cross-platform use* — numerous user experience issues with extant PIM-platforms were noted during the study. These issues are reviewed as part of the discussion in Section 3.6.

Components of the work reported on in this chapter have been published in Buttfeld-Addison et al. (2009) and Buttfeld-Addison et al. (2012).

## 3.3 Online Questionnaire

The first component of the pilot study was an online questionnaire. The objective of the questionnaire was to provide an initial set of data upon which the empirical basis



for the remainder of the work could be set: an up to date overview of the state of knowledge workers' PIM.

The full set of objectives for the entire pilot study was discussed in detail in [Section 3.2.1](#). Experimental materials for the online questionnaire are available via <http://paris.id.au/>.

The remainder of this section, exploring the decisions behind, scope, design, and analysis of the online questionnaire, is structured as follows:

- [Section 3.3.1](#) discusses the choice of methodology;
- [Section 3.3.2](#) discusses the scope of the questionnaire;
- [Section 3.3.3](#) discusses the design of the questionnaire;
- [Section 3.3.4](#) discusses recruitment and participation for the questionnaire;
- [Section 3.3.5](#) discusses the analysis techniques used for the questionnaire data.

### 3.3.1 Choice of Methodology

A questionnaire was selected as the first component of the pilot study. Questionnaires are a well established data collection method for PIM research. While questionnaires only provide a snapshot of data regarding the phenomena under study, and can be highly subjective, they are useful in facilitating a basic, or initial, understanding of participant needs and experiences ([Gillham, 2000](#); [Kjeldskov and Graham, 2003](#); [Lazar et al., 2010](#)).

Specifically, a questionnaire was chosen for this component for the following reasons:

- it allowed access to a significant number of participants with minimal time commitment required on their part ([Gillham, 2000](#); [Kjeldskov and Graham, 2003](#));
- large amounts of data can be gathered through a relatively small amount of effort from the researcher ([Foddy, 1994](#); [Kjeldskov and Graham, 2003](#));
- questionnaires facilitate a great understanding of phenomenon for building future theory upon ([Foddy, 1994](#); [Gillham, 2000](#); [Kjeldskov and Graham, 2003](#));
- questionnaires excel at providing a snapshot of participants, useful for developing future studies ([Gillham, 2000](#); [Kjeldskov and Graham, 2003](#)).

As was discussed in [Section 2.3.1](#), many past studies, as well as PIM studies in particular, have made extensive use of questionnaires ([Lazar et al., 2010](#)).

### 3.3.2 Scope

Using past research as guidance to determine an appropriate scope for this study was not straightforward. Past literature alone does not provide sufficient background information with which to begin a new exploration of the issues surrounding PIM, primarily because the nature of the platforms used for PIM has evolved so fast in the past decade (Jones, 2012; Detraux and Scapin, 2013).

Similarly, whilst the focus of the pilot study was upon PIM broadly in order to explore the context of tablets, it must be acknowledged that there is little past research regarding tablet technologies and PIM —largely due to tablet technologies not being as widespread as they are in the present day, as was touched on in Section 3.2, and Chapter 2.

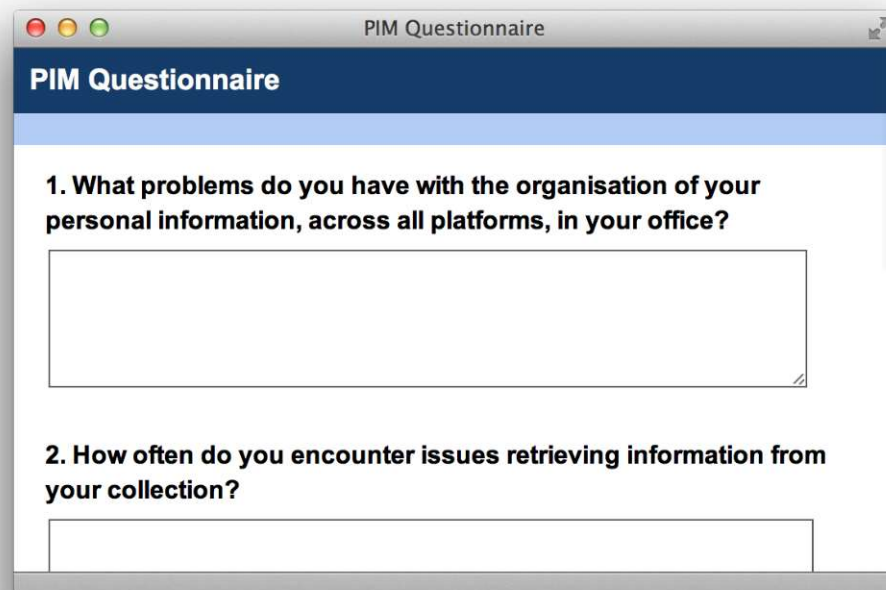
The desire, therefore, to build an initial basis understanding of PIM, and the context of tablets on which to found the research meant that the focus of the investigative instruments used in this first component and phase strongly embrace the pilot nature of this phase, and also contain little in the way of pre-formulated hypotheses. They seek to illuminate cross-platform PIM and the use of tablets, so that more focused phases and studies may follow. The scope constraints of the overall project were previously discussed in Section 1.2.1.

### 3.3.3 Design

The design of the questionnaire was inspired by those conducted for past PIM research (e.g. Coughlan and Johnson, 2009; Bergman et al., 2013; Detraux and Scapin, 2013). It was structured as a series of basic questions that participants could answer, in text form, with as much or as little detail as they desired. Examples of questions asked of participants in the online questionnaire component include:

- What problems do participants think they have with the organisation of their personal information, across all platforms, in their office?
- How often do participants encounter issues retrieving information from their collection?
- What sort of organisation and maintenance do participants employ on their collections?
- Do participants organise and maintain their collections differently, depending on where the collection is kept?
- What platforms do participants commonly use?

In seeking to provide a picture of the problems individuals have in managing personal information in an office environment, the questionnaire included queries such as the number of times per week they estimated they were unable to find something they required, how organised they considered themselves, whether they treated digital and physical PIM differently, and what their biggest PIM problems were.

The image shows a screenshot of a web browser window titled "PIM Questionnaire". The window has a dark blue header bar with the title "PIM Questionnaire" in white. Below the header, the first question is displayed: "1. What problems do you have with the organisation of your personal information, across all platforms, in your office?". This question is followed by a large, empty rectangular text input box. Below this, the second question is displayed: "2. How often do you encounter issues retrieving information from your collection?". This question is followed by a smaller, empty rectangular text input box. The interface is clean and professional, with a white background and clear, black text.

**Figure 3.3:** Example screen of pilot study online questionnaire

Standard techniques for questionnaire development were followed when designing the survey: queries about behaviour were limited to a specific time period (e.g. "in the past month, what are..") in order to raise the validity of answers by improving participants' estimates and open-ended questions were employed in order to provide participants with the opportunity to answer broadly, without forcing themselves in answers implied by the question (Sue and Ritter, 2011).

The questionnaire was designed and implemented as a website using popular questionnaire-tool *SurveyMonkey* (Wright, 2006). An example of the format the survey was distributed in is shown in Figure 3.3.

### 3.3.4 Participation

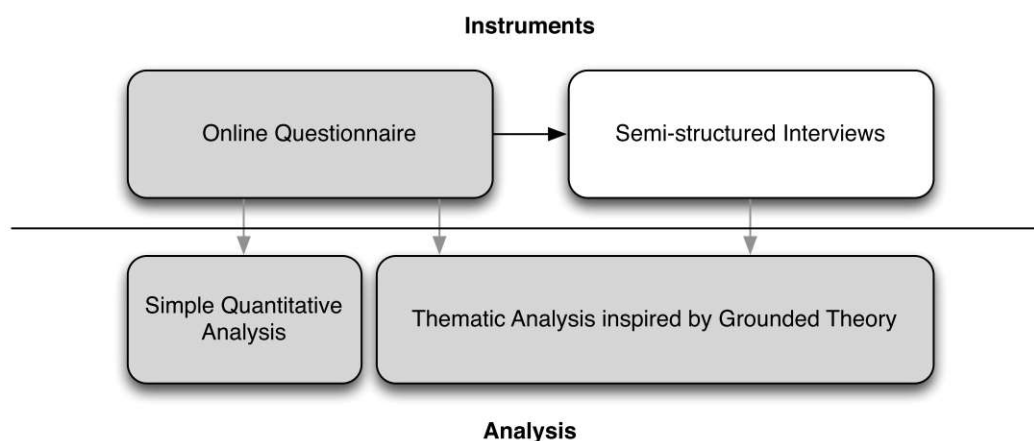
As was noted in Section 1.2.2, those employed as knowledge workers were the focus of all phases of the research project, and recruitment of participants was targeted at or-



organisations that typically employ people as knowledge workers (Carleton, 2011). Targeted knowledge worker occupations included lawyers, accountants, and academics. Organisation included numerous companies, small startups, universities, legal and financial institutions and multinational corporations. The questionnaire reached significantly beyond the local population, with participants being sourced in the United States, United Kingdom, Sweden, Hong Kong, New Zealand, Canada, and Australia. Recruitment was directed at a wide range of industries with the goal of avoiding a bias towards the technology industry.

Recruitment for participants took place between mid-2010 and mid-2012, and analysis took place in parallel, commencing following the first sets data collection. No material incentive, financial or otherwise, was offered in return for participation in the study. Recruitment was performed via email – the researcher reached out to contacts at a wide range of companies employing knowledge workers, asking each to spread the call for participation widely within their company.

The second component of the pilot study comprised a series of semi-structured interviews with a subset of questionnaire participants. The online questionnaire contained a question as to whether the participant would be willing to participate in a follow-up interview. This question was used to recruit interview participants, with all those who indicated "yes" in the questionnaire participating in the interviews. The semi-structured interviews are discussed in Section 3.5.



**Figure 3.4:** The analysis techniques used for the online questionnaire component of the pilot study

### 3.3.5 Analysis

Two distinct analysis techniques were used on the online questionnaire data from this phase, they were:

1. a thematic analysis (Braun and Clarke, 2006) of the responses to free-form questions, designed to identify challenges of specific platforms, problems, and activities, and provide a picture of the context of the tablet;
2. a simple quantitative collation of the data from the questions on profession, organisation level, frequency of problems, and the mentions of PIM-platforms and PIM-tools.

The thematic analysis was the most meaningful of the two forms of data analysis, whilst the simple quantitative data was collected to give context to the qualitative results. Data collection for the pilot study took place from mid-2010 to mid-2012. The long period of data collection was deliberate, since it allowed for a modicum of control over the *newness* of tablets as a technology; by the mid- to late-stages of the data collection and analysis, tablets were a well-established and common piece of technology (Nguyen and Chaparro, 2012; Li, 2012). The data analysis techniques chosen were also well suited to this continual collection and analysis (Boyatzis, 1998; Braun and Clarke, 2006). Analysis techniques were previously discussed in Section 2.3.1.

A number of initial findings developed using these analysis techniques are necessary for comprehending the remaining work in this chapter. These initial findings are presented in Section 3.4. A detailed discussion of the overall findings, together with those from the semi-structured interview component —discussed in Section 3.5 —is presented in Section 3.6. Figure 3.4 illustrates the two analysis techniques in context, and the following two sections report on each analysis technique in turn.

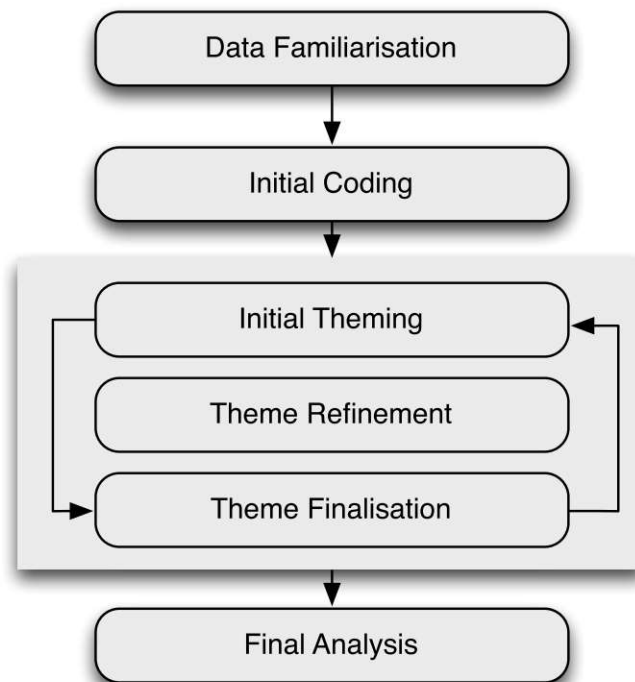
#### 3.3.5.1 Qualitative Analysis



This section outlines the qualitative analysis, a thematic approach, performed on the data from the online questionnaire component of the pilot study. Thematic analysis frequently has a poor reputation; Braun and Clarke (2006) observe that it is “*poorly demarcated, rarely-acknowledged, yet widely-used*”. When used in a deliberate way, however, thematic analysis has been noted to be a highly flexible, accessible, and useful approach for qualitative analysis (Boyatzis, 1998; Roulston, 2001; Braun and Clarke, 2006).

The approach used here is a variation of that proposed by Braun and Clarke (2006), initially for use in the psychology discipline. The process is broken into the six phases of analysis shown in Figure 3.5; the phases are occasionally followed recursively, rather than linearly. Thematic analysis is a useful approach for HCI-related work, since it allows for the representation of patterns of participants' experience, and while it may be unsuitable for detailed theory-building due to its lack of multiple levels of





**Figure 3.5:** Stages of thematic analysis used for the pilot study

abstraction, it is exceptional at this fundamental "discovery stage" (Henwood and Pidgeon, 1992), where it is sought to establish a basis for new research (Adams et al., 2008). Therefore, the researcher considered it suitable for use in the analysis of Phase 1 of this work, a pilot study. The stages of this thematic analysis are:

1. *Data Familiarisation* — the notation of initial ideas during a review stage to ensure that the researcher had a strong familiarity with the data;
2. *Initial Coding* — the coding of the data, systematically, linking of codes together across the entire collection of data and identifying the most interesting features of the data;
3. *Initial Theming* — codes are grouped into tentatively identified themes, with more coding being performed as necessary. The first thematic maps, which are visualisations of the themes within the data, are developed at this stage (Boyatzis, 1998);
4. *Theme Refinement* — reviewing themes to ensure validity against snapshots of the data, revising those themes and generating an initial thematic map;
5. *Theme Finalisation* — "define and refine themes" (Braun and Clarke, 2006), finalising



the names and identity of each theme and refining the narrative of the results of the analysis;

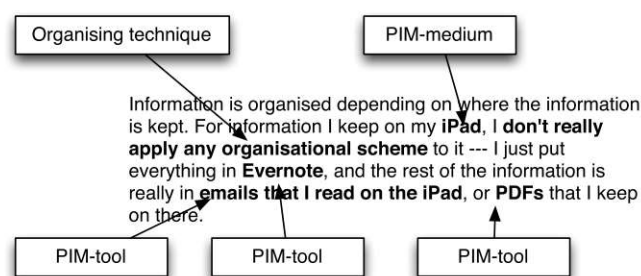
6. *Final Analysis* —finalisation of thematic map, identification of concise, genuine, compelling example data and referral back to objectives.

The results from the application of this approach are discussed with the other findings from the pilot study in [Section 3.6](#). Each of these stages, and how it was applied to the questionnaire data, is now discussed in turn.

**Data Familiarisation** The raw data were reviewed until the researcher was extremely comfortable and intimately familiar with it. Significant notes were made on the potential for future coding, but no actual coding was conducted in this stage ([Braun and Clarke, 2006](#); [Adams et al., 2008](#)). At the point when the researcher believed that he was comfortable with the data, initial coding could begin.

**Initial Coding** The first coding stage, where interesting features of the data were identified, was now performed. Consider the following participant quote:

*"Information is organised depending on where the information is kept. For information I keep on my iPad, I don't really apply any organisational scheme to it, I just put everything in Evernote, and the rest of the information is really in emails that I read on the iPad, or PDFs that I keep on there."*



**Figure 3.6:** An extract of online questionnaire data, with codes applied

[Figure 3.6](#) shows an example of the very first stage of codes being applied to the same participant quote. The definition of a code, as applied here, comes from [Boyatzis \(1998\)](#): "the most basic segment, or element, of the raw data or information that can be assessed in a meaningful way regarding the phenomenon."

A large variety of codes were developed during the initial coding phase, as was the goal. The core features (core codes) found in the online-questionnaire data included:

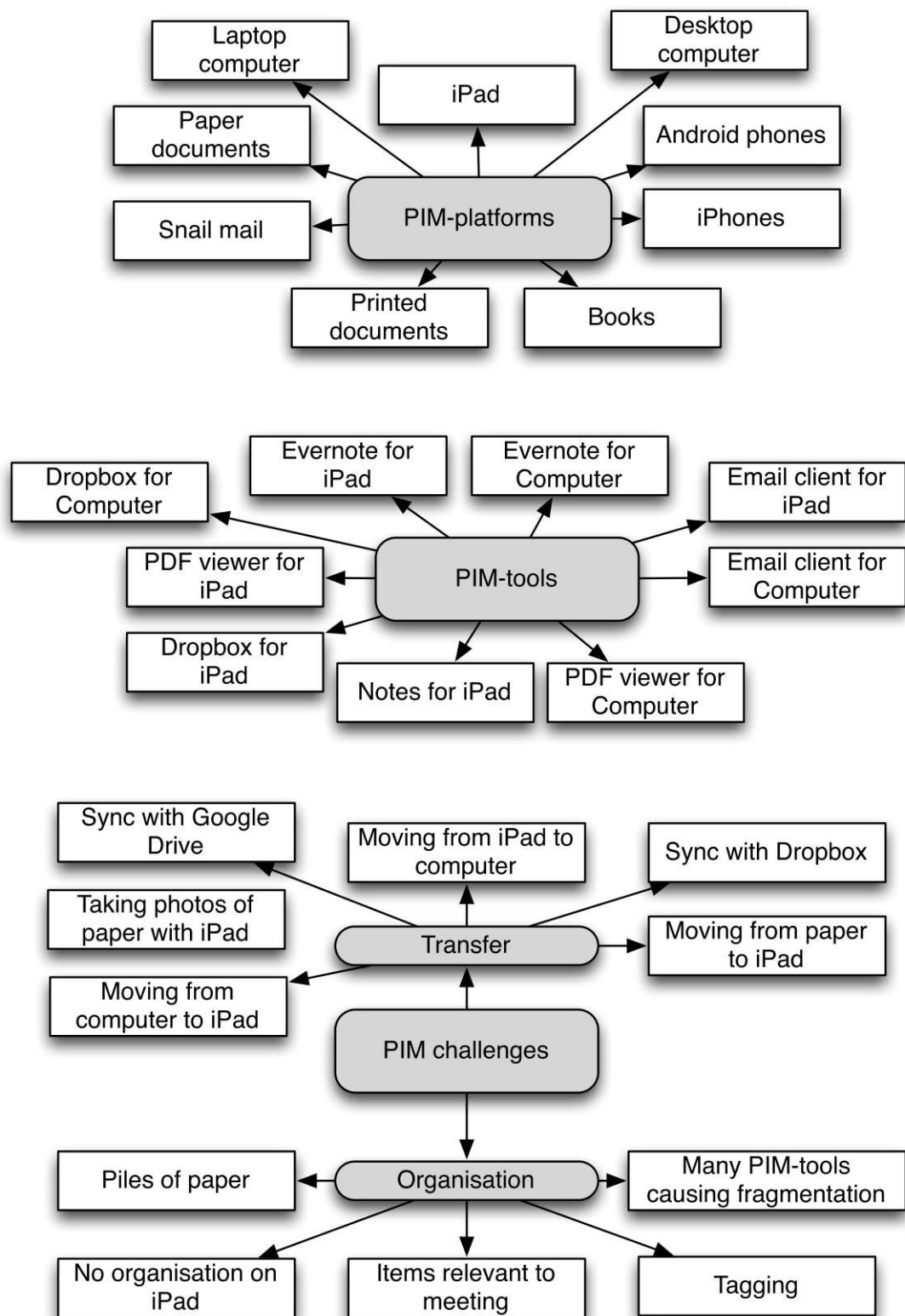
- PIM-platforms
- software PIM-tools
- PIM challenges:
  - transferring
  - context
  - finding
  - miscellaneous problems
- sorting/organising techniques
- browsing techniques
- searching behaviour
- explicit role of the tablet in PIM
- implicit role of the tablet in PIM

**Initial Theming** In this stage of analysis, the wide collection of codes that were developed is sorted into themes. Coded snippets (largely quotes) from the data were also collected, and matched with the newly identified themes for future reference.

The development of thematic maps is particularly key to the thematic analysis technique that was used here (Fereday and Muir-Cochrane, 2008). The process of developing the thematic maps is spread across several stages of the analysis and involves the evolution of initial thematic maps into final versions. The initial thematic maps are a visualisation of the patterns in the data, showing the relationships between areas, or themes, in the data. Importantly, as Boyatzis (1998) notes, a thematic map does not have to “smooth out or ignore the tensions and inconsistencies within and across data items”. Thematic maps are, therefore, often contradictory and repetitive in nature (Fereday and Muir-Cochrane, 2008).

The initial thematic maps are developed after all the data has been coded and reviewed. They are designed to help the researcher focus their analysis on the themes in the data, rather than deep in the codes (Braun and Clarke, 2006; Adams et al., 2008). Each code is considered on its own, and together with other codes, they are grouped as appropriate to form overarching themes. The initial thematic maps are simply a visual representation of this.

An example of one of the initial thematic maps developed using this technique is shown in Figure 3.7. This initial map clearly shows the main overarching themes forming, as well as sub-themes — the significance of certain themes is becoming clear.



**Figure 3.7:** An example of one of the early thematic maps developed from the online questionnaire



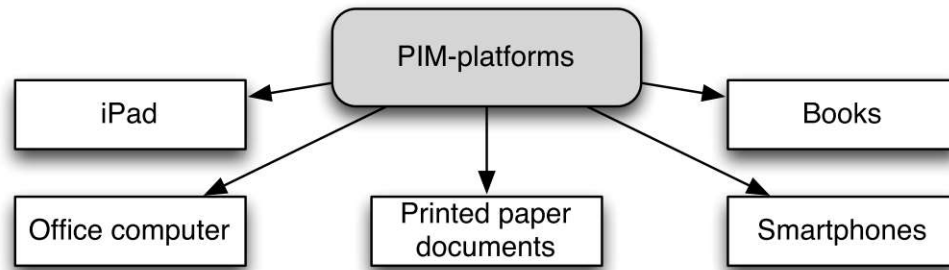
The central themes identified in the initial theming stage of the analysis of the online questionnaire data were:

- the core PIM-platforms used by participants;
- the core software PIM-tools used by participants;
- the wide range of techniques employed across PIM-platforms by participants —how, and why, participants moved information between PIM-platforms and PIM-tools;
- the wide range of organisation, maintenance and retrieval techniques employed across PIM-platforms by participants;
- how common emailing documents between PIM-platforms was amongst participants.

**Theme Refinement** The process of evolving this initial thematic map into its final form is used to move from the refined themes to the finalised, defined themes. [Boyatzis \(1998\)](#) observes that it is during this stage that it will become apparent that many themes are not actually themes due to lack of sufficient data or strong similarity to other themes; likewise, some themes may, at this point, split into multiple themes. Literature on how to appropriately judge categories and internal/external homogeneity is helpful at this point (e.g. [Patton, 2001](#)).

An example of one of the finalised thematic maps developed during this analysis is shown in [Figure 3.8](#). The process of finalising the themes is one of constant return to the data, reconfirming and identifying new patterns ([Aronson, 1994](#)). Patterns which become themes are typically derived from things such as the vocabulary used, feelings expressed, metaphors, proverbs, or meanings expressed, and activities ([Aronson, 1994](#); [Taylor and Bogdan, 1998](#)).

**Theme Finalisation** In this stage, the finalised thematic maps were used to clearly define, and further refine if necessary, the spirit of each theme: the aspect of the data that each theme encapsulates was identified at this point. The advice of [Braun and Clarke \(2006\)](#), who suggest that it is important to not make a theme complex, wide ranging or diverse, was dutifully followed at this point. The coded snippets of data that were identified in the initial theming stage were revisited and organised into a narrative, of sorts. The specific components of these snippets that were of interest to the study were noted as well. Themes that have emerged from participants' data get pieced together which allows each individuals' reported experiences to form part



**Figure 3.8:** An example of a piece of one of the finalised thematic maps developed from the online questionnaire

of a "comprehensive picture of their collective experience" (Leininger, 1985; Aronson, 1994; Adams et al., 2008).

Each theme was also reviewed for appropriateness, and a detailed description of each was written; overlap, and any sub-themes, themes within themes, were also identified, giving more structure to the complex themes, as well as hierarchy to the data as a whole (Braun and Clarke, 2006).

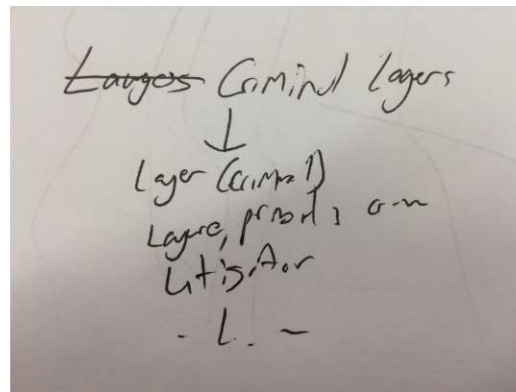
**Final Analysis** The final stage involved the development of a final narrative and presentation of the salient themes developed. Specific snippets of those identified in the earlier phases of analysis were selected for presentation in the thesis, and the data was related back to the objectives of the study.

The final analysis involved the review, and further generation, of a significant volume of annotations and documentation regarding the data (Adams et al., 2008). Findings identified through thematic analysis are presented partially in Section 3.4, and finally in Section 3.6.

### 3.3.5.2 Quantitative Analysis

The quantitative analysis performed on the relevant data of the questionnaire component was quite simple. This simple quantitative analysis involved a collation of the data from the questions in the online questionnaire related to such things as profession, organisation level, frequency of problems, and mentions by each participant of PIM-platforms and PIM-tools. Simple collation of such quantitative data is common practice in many HCI and HCI-related studies (Nielsen, 1994; Adams et al., 2008; Lazar et al., 2010).

An example of one of the rough notes made by the researcher during the collation of the online questionnaire data relating to the professions reported by participants is shown in Figure 3.9.



**Figure 3.9:** Example of rough notes made by the researcher during simple quantitative analysis of questionnaire responses

## 3.4 Initial Findings

This section reports on the initial findings from the online questionnaire component of the pilot study. These findings primarily relate to the identification of the context, the PIM-platforms and PIM-tools, alongside which tablets are used for PIM, but also provide basic information on profession and other demographics of participants.

The identification of the context in which tablets are used by knowledge workers for PIM was the primary objective of this study, as noted in [Section 3.2.1](#). These PIM-platforms and PIM-tools, as reported to be used by participants of the online questionnaire alongside their tablet, are reported on and justified. The results from this section are solely from the online questionnaire component of the pilot study, and are structured as follows:

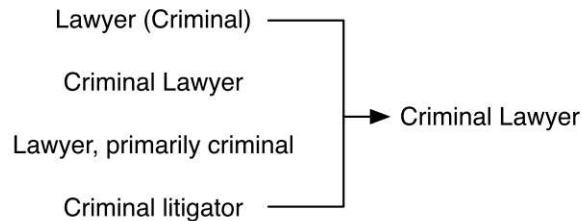
- [Section 3.4.1](#) reports on the participants of the online questionnaire;
- [Section 3.4.2](#) begins the exploration of the context of tablets in PIM by exploring the most common PIM-platforms and PIM-tools used alongside;
- [Section 3.4.3](#) reports on participants experiences with a type of personal information known as "micronotes";
- [Section 3.4.4](#) concludes the initial findings with a summary and brief discussion.

### 3.4.1 Participants

The questionnaire was completed by 507 respondents. 56% of respondents reported as male, and 44% reported as female; 100% of the professions reported by participants fit the researcher's definition of a knowledge worker, first noted in [Chapter 1](#). The questionnaire was distributed widely via email to workers at numerous local small



businesses, medium- to large-companies, universities, legal and financial institutions and multinational corporations. The reported age range of participants spanned from 22 to 68 years of age.



**Figure 3.10:** Participant professions demonstrating an example of data massaging for "Criminal Lawyer" profession

Participants were asked to provide their profession in a free-form text field during the questionnaire. Minor massaging of the data was performed in order to effectively tally each reported profession. For example, [Figure 3.10](#) shows the responses by participants that were combined into the profession of "Criminal Lawyer". This combination of codes, in this case very specific codes that represent professions, is a technique commonly employed as part of a thematic analysis ([Braun and Clarke, 2006](#)). There was not a significant bias towards participants employed in information technology-related knowledge work, as they constituted less than 6% of participants. Knowledge workers were specifically targeted by the recruitment material, however. Participants were not required to be tablet users, and no mention of tablets was made in recruitment material for the online questionnaire.

Component	Count
Online questionnaire	507
Semi-structured interviews	96

**Table 3.1:** Participant count for the online questionnaire

Compared to other questionnaires conducted in the PIM area, such as [Ducheneaut and Bellotti's \(2001\)](#) and [Jones et al.'s \(2005\)](#), as well as suggested numbers for largely qualitative questionnaire research ([Fink, 2002](#)), the level of participation in this study was both strong and appropriate.

By way of the question regarding future participation, noted earlier in [Section 3.3.4](#), 96 of the questionnaire participants agreed to return for the interviews. All those who agreed ultimately returned. The participation rate for both components of this phase is shown in [Table 3.1](#).

3.4.2 Context of the Tablet

The first set of initial findings from the pilot study illustrates the context of the tablet in the cross-platform PIM ecosystem of the knowledge worker participants. Mentions of specific PIM-platforms and software PIM-tools were collated from questionnaire participants' free-form responses, and the results are reported in this section. This section seeks to provide illumination on the following queries:

- 1. What are the most common PIM-platforms that tablets are used alongside?
- 2. What are the most common software PIM-tools used on, and with —even on other PIM-platforms — tablets?

These queries specifically address the objectives of the pilot the study that were discussed in [Section 3.2.1](#) and support a line of enquiry into addressing the objectives of the thesis as a whole that were discussed in [Section 1.2.1](#).

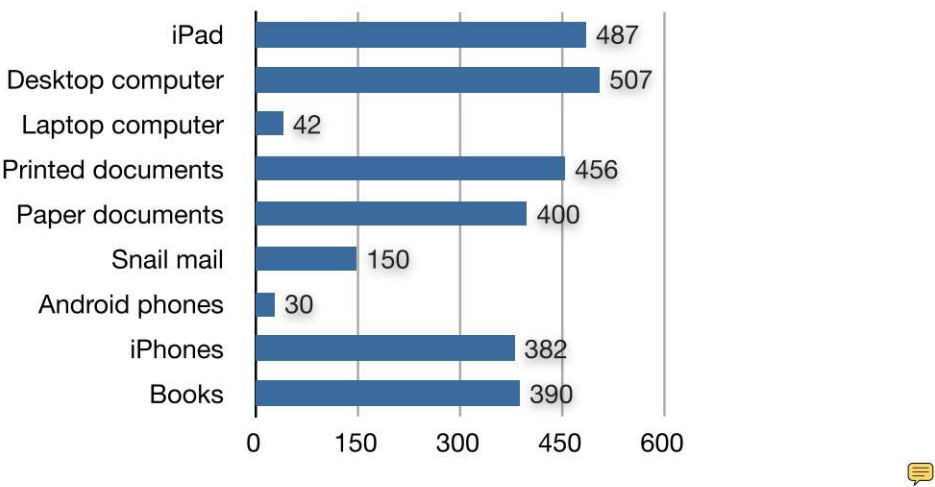


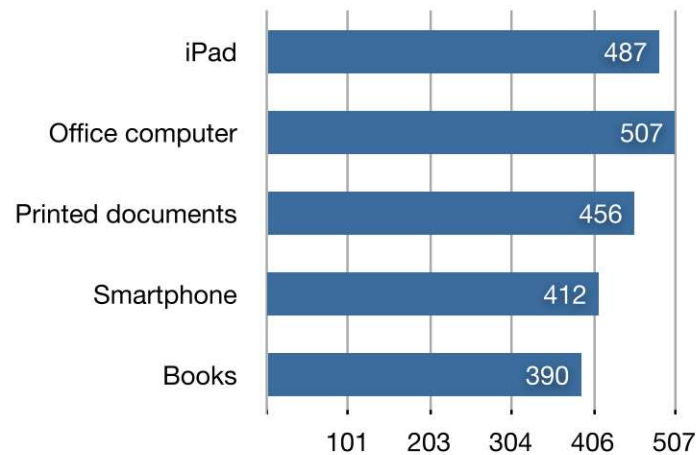
Figure 3.11: Participant count for each PIM-platform mentioned in the online questionnaire [n=507]

3.4.2.1 PIM-platforms

All participants of the online questionnaire reported managing their personal information across multiple platforms. The full set of data, a summary of which is shown in [Figure 3.11](#), was reduced to the six most frequently mentioned PIM-platforms, also shown in [Table 3.2](#).

Validating one facet of the research focus, tablet technologies and more specifically, solely the Apple iPad itself, were the most frequently mentioned PIM-platform. This was not entirely unexpected, given the dominant marketshare of the Apple iPad

amongst other tablet products. At the time of writing, the marketshare of the Apple iPad has been estimated to sit at around 80% and, at the time of writing, is rising ([Cusumano, 2013](#); [Tellis, 2013](#)).



**Table 3.2:** Participant counts for the most frequently mentioned PIM-platforms

The most prevalent PIM-platforms reported by participants of the online questionnaire are discussed below, using data from the thematic analysis of the online questionnaire —discussed in [Section 3.3.5](#)—to support the discussion:

1. *Tablet* —despite the intention of the research to cover all modern forms of tablet devices (as discussed in [Chapter 1](#)), Apple's iPad was the only tablet product actually reported by participants. This tablet, shown [Figure 3.12](#), was one of the most frequently mentioned PIM-platforms in the online questionnaire with 96% of participants noting that they used an iPad. The remaining 4% did not mention any form of tablet, but they did not explicitly report that they did not utilise one.
2. *Office computer* —Somewhat naturally, the second most frequently mentioned PIM-platforms was the office computer: traditional computers running Microsoft Windows, Apple Mac OS X, and Linux. 94% of participants in the online questionnaire mentioned their office computer. Participants mentioned a variety of operating systems being in use on their office computer, but the question was not specifically asked. The researcher did not feel that it was relevant to the study, given the homogeneity of modern desktop software ([Marinacci, 2012](#)). Laptop computers were mentioned by a small number of participants, as most deferred to their provided work desktop.



3. *Paper documents* —encompassing physical mail, printed documents, and paper documents otherwise delivered to or created by the individual.

90% of the participants mentioned paper documents, printed or otherwise. When contrasted to the 96% of participants who mentioned the iPad, this on its own provides an interesting anecdote on modern PIM.

4. *Smartphone* —including iPhone devices and Android devices.

The smartphone, reported by participants as both Android-based phones and Apple iPhones ([Apple, Inc., 2013a](#)), was high up in the list of most frequently mentioned PIM-platforms. The prevalence of the tablet (specifically the iPad) above the smartphone surprised the researcher, given the relative market shares of the device types ([Jackson, 2010](#); [White, 2013](#)). At the time of writing, the smartphone has a significantly higher market penetration than any form of tablet ([White, 2013](#)).

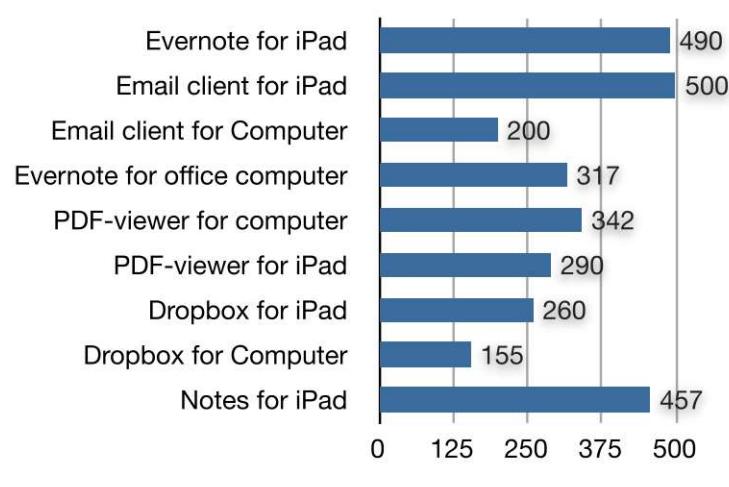
5. *Books* —lending credence to the idea that we are still a long way off from the paperless office (see [Section 2.4.1](#), amongst others in [Chapter 2](#)), the book —of the traditional "dead tree" variety —was mentioned by many participants as a core PIM-platform in their daily work.



**Figure 3.12:** The iPad, tablet of choice for 96% of online questionnaire participants (the remaining 4% did not use a tablet)

### 3.4.2.2 PIM-tools

All participants similarly reported that they manage their personal information using a variety of software PIM-tools. Participants who mentioned specific PIM-tools in their free-form responses were counted. Only participants who reported using a tablet — and, as it turned out, an iPad — were included in this, since the goal here, as noted in [Section 3.4.2](#), was to identify the most common software PIM-tools that are used on, and with, tablets.



**Figure 3.13:** Participant count for each PIM-tool mentioned in the online questionnaire [ $n=507$ ]

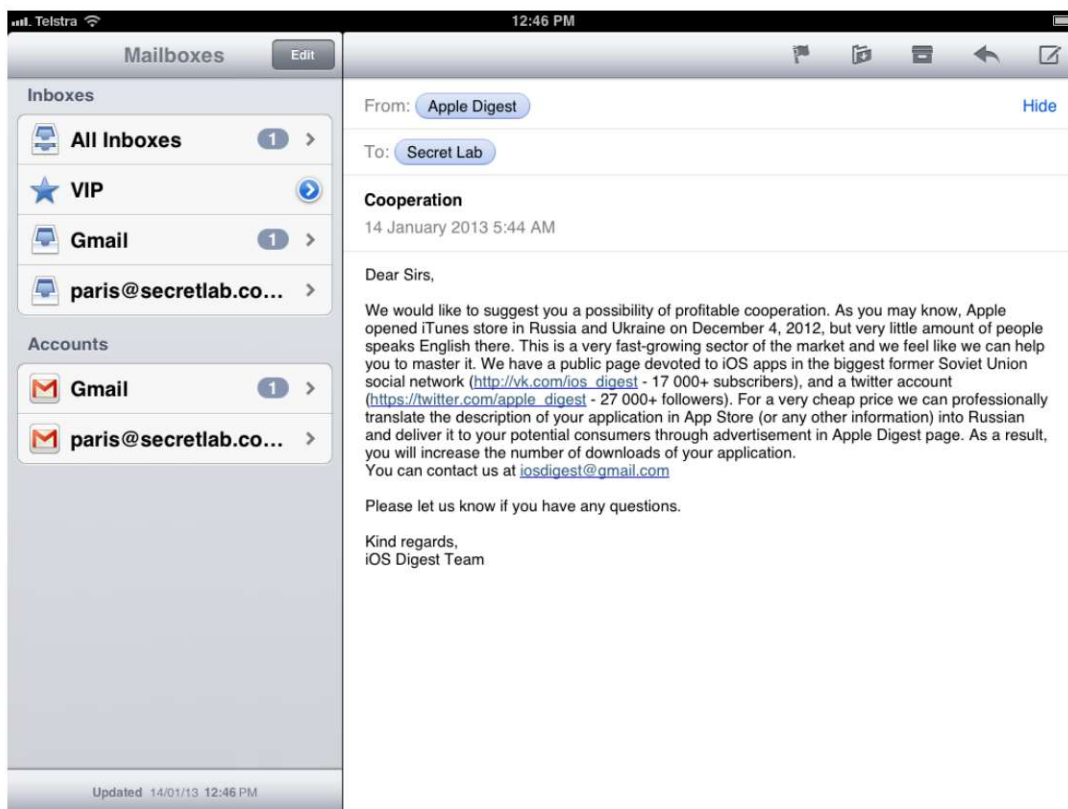
Overwhelmingly, tablet-using participants mentioned two specific PIM-tools. Many other software PIM-tools were mentioned, but these were largely specific pieces of software used by a limited number of participants. A list of the most frequently mentioned PIM-tools is shown in [Figure 3.13](#).

Since the researcher is concerned with generally applicable PIM research, it was decided to focus on the two most frequently mentioned PIM-tools, particularly as they had formed the focus of previous PIM research that was not focused on tablets, such as [Whittaker and Sidner \(1996\)](#) or [Boardman's \(2004\)](#) work. This past research context allowed for a better understanding and exploration of the two PIM-tools focused upon. These two PIM-tools of focus, reported as used by participants, were:

- *Email* — Reports of the death of email ([Judd and Kennedy, 2010](#)) may be something of an exaggeration. The, at this point ancient ([Leiner et al., 2009](#)), communication and information management technology was mentioned by almost every single participant in responses to the online questionnaire. A screen from the email client for the iPad, which was frequently mentioned by many participants, is shown in [Figure 3.14](#).



- *Document files* —computer document files rank highly in participant responses. The perennially popular document format (Adobe Corporation, 2013), and associated viewers, PDF, was the most mentioned format for this PIM-tool by the majority of participants. This suggests that digital document-based PIM, when it is not involving email, likely revolves around the documents such as the PDF —an observation reinforced by past research (e.g. Zhang and Twidale, 2011).



**Figure 3.14:** The default view of the email client for iPad, as of iOS 6.0

It is important to note that these PIM-tools are not the focus of this thesis. Their identification as prevalent for use with tablets merely allows for a discussion to be formed around the particular cross-platform PIM challenges inherent tablets.

### 3.4.2.3 Summary

Understanding the context of the PIM in which tablets sit was an important first step in this research project. This section has, in providing initial answers to the queries noted in Section 3.4.2, suggested that the most common PIM-platforms used alongside tablets are the office computer and printed documents, and the most common PIM-tools used with tablets are email and document files. It is this combination of PIM-platforms and PIM-tools that shall form a focus for the remainder of the discussion of



the challenges of cross-platform PIM conducted in this thesis.

### 3.4.3 Micronotes

Micronotes refer to the notes that people make that do not fit into a formal information organisation structure (Lin et al., 2004; Bernstein et al., 2008; Ispas et al., 2012). Micronotes are sometimes referred to as information scraps, and are typically brief in nature. Micronotes are scrawled in the margins of other information items, on the back of envelopes, sticky notes, and similar (Bernstein et al., 2008). Micronotes were initially discussed in Section 2.2.3. Lin et al. (2004) suggest that micronotes "*focus on present information and its future use*", as compared to the intent of more formal notes, that might serve to remind individuals of that which has already been experienced (Neisser and Hyman, 1999).

The researcher found it unexpected that participants of the online questionnaire component of the pilot study broached the topic of micronotes at all, much less with the prevalence that eventuated. A large proportion of participants mentioned, in their free-form answers, the challenges they faced with micronotes (although none referred to them with such nomenclature). These participants typically reported along the lines of the following free-form participant response:

*"I have a lot of problems with the scrappy notes I make on my iPad, usually about things I'm worried I'll forget to do. Before I got the iPad a year or so ago, I used to maybe put these sorts of notes on paper on my desk, or sticky notes next to my screen, but now they're on the iPad. I'm finding I act on them a lot more often, I guess, but they're a lot more unmanageable because they just fill up the iPad. It's digital so I don't bother cleaning it up like I used to with the stickies?"*



212 participants from the online questionnaire mentioned something resembling micronotes. The researcher considered this response rate regarding micronotes, nearly 42% of online questionnaire participants, to hold some significance since the questionnaire instrument made no mention of scrappy notes, micronotes, or similar.

All participants who mentioned micronotes also mentioned using a tablet, and 76% of these participants mentioned micronotes and their tablet together as posing an organisational problem for their PIM. This potential challenge, as well as the use of tablets for micronotes, was unanticipated. The nature of micronotes, as related to the use of tablets, was therefore followed up by the semi-structured interview component of the pilot study, and in Phase 2 of the overall research project.

### 3.4.4 Discussion

The vast range of PIM-platforms used by participants illustrated the cross-platform nature of PIM, suggesting that any study of PIM should take the cross-platform nature as a distinct focus. This observation strengthens the premise of the research, and reinforces the existence of a research gap.

The initial findings reported on throughout [Section 3.4](#) have highlighted the tablet, the office computer, and paper as the PIM-platforms under focus for the entire research project. These PIM-platforms were selected for focus since, in addition to being the three most frequently mentioned platforms in the pilot study, they each provided opportunity for understanding the realities of a present-day knowledge worker's PIM but were sufficiently constrained in scope so as to make the further phases of the study feasible.

The specific cross-platform focus of the work to be presented in this thesis was determined through the results of the first component of an pilot study —through this online questionnaire the most commonly used PIM-platforms and PIM-tools of participants were revealed.

Together with the tablet, the office computer and paper documents were considered strong, and highly viable focus platforms for the research for the following reasons:

- *wide-ranging research base* —significant study of the office computer and paper documents as personal information spaces has been conducted in past PIM research, which provides groundwork for the present study —this was previously discussed in [Section 2.2](#);
- *wide range of extant PIM-tools* —the office computer is a diverse PIM ecosystem with myriad studies of PIM, extant PIM-tools, and design recommendations for PIM-tools;
- *fundamental artefact of PIM* —paper documents (in this case those printed by knowledge workers in their office) are the quintessential item of personal information and have formed the basis for numerous past studies of PIM —this is also an historical link to the earliest of PIM research (such as the pioneering work of [Malone 1983](#)).

The knowledge of the most prevalent tools in this study —email and document files —would also help drive discussion in later components of the research project. Likewise, an understanding of common PIM-tools such as email and document files provided an increased understanding to the context in which the tablet is used.



The initial focus of the remainder of this work has been clearly established by the pilot study, as the study was intended to do. At this point, it was also becoming apparent that existing models —such as Barreau's (1995) —do not adequately represent the true state of cross-platform PIM. The following section reports on the design and process of the semi-structured interviews conducted as the second component of this pilot study. The findings from the entire study are then reported in Section 3.6.

## 3.5 Semi-structured Interviews

The second component of the pilot study was a series of semi-structured interviews. The objective of these semi-structured interviews was to explore the material established in the questionnaire component in detail by conducting an investigation of the specific challenges encountered in managing personal information across the focus PIM-platforms, with particular attention paid to the tablet, and the PIM-tools identified during the online questionnaire.

This section reports on the design and conduct of the semi-structured interviews. The objectives of the pilot study were discussed in detail in Section 3.2.1. A copy of the experimental materials related to these semi-structured interviews is available via <http://paris.id.au/>.

The remainder of this section, exploring the decisions behind, scope, design, and analysis of the semi-structured interviews, is structured as follows:

- Section 3.5.1 discusses the choice of methodology;
- Section 3.5.2 explains the scope of the semi-structured interviews;
- Section 3.5.3 discusses how the semi-structured interviews were designed and prepared;
- Section 3.5.4 discusses recruitment and participation in the semi-structured interviews;
- Section 3.5.5 notes how data from the semi-structured interviews was analysed.

### 3.5.1 Choice of Methodology

Semi-structured interviews were selected to follow on from the questionnaire as the second component of the pilot study since they allow for the effective, yet slightly contradictory, combination of great flexibility with rigidity as needed (Drever, 1995). Since a key aspect of this study was the examination of real-world practice, the natural setting, flow, and flexibility of semi-structured interviews held in participants' offices



was deemed most suitable. The use of semi-structured interviews for qualitative research is common (Robson, 2002), and they are also particularly prevalent, accepted, and strong methods for PIM research (Whittaker and Sidner, 1996; Boardman, 2004).

The flexibility inherent to their semi-structured nature strengthens the ability to explore real-world behaviours in a very natural setting. An extremely social method, semi-structured interviews are often employed early on in the process of designing a new system (Robson, 2002) as they allow for the close consideration and examination of people, and the situations in which they work (Barriball et al., 1994), all facets which made them suitable for employment as part of the first phase of this research. Semi-structured interviews were previously discussed in Section 2.3.1.

### 3.5.2 Scope

The nature of the pilot study's objectives and the potential for semi-structured interviews to become derailed due to their potentially unfocused nature (Drever, 1995; Robson, 2002) meant that it was necessary to carefully constrain the scope of this component of the study. The semi-structured interviews were constrained in the following ways:

1. *focus on PIM practice within an office environment* —the domain of interest was limited to the office environment, but not necessarily the specific individual office, where each participant performed the majority of their PIM at their place of work. Interviews were conducted in the specific office of the individual, a common strategy in social research (Thomson, 2012b);
2. *focus on three PIM-platforms* —even within the context of one office environment, users employ a wide and varying range of PIM-platforms (Detraux and Scapin, 2013).

The study was therefore focused on the three most commonly-used PIM-platforms identified: the tablet, the primary office computer, and paper documents. This focus was determined from the results of the online questionnaire component; the selection of the PIM-platforms for focus was previously discussed in Section 3.4.

3. *non-longitudinal study* —as noted in Chapter 2, PIM is an ongoing activity, and user behaviour may evolve over time (Bälter, 1997). However, like most of the previous studies discussed in Chapter 2, this investigation was based on a one-off snapshot of behaviour.

4. *focus on personal rather than shared information* — as noted in [Chapter 2](#), personal information may be stored within a group information space, such as a network drive or common filing cabinet.

To avoid taking into account issues related to collaboration, this study focused on information that was not explicitly shared with other individuals, typically through automated means. The definition of personal information used as the basis of this work was initially presented in [Section 1.4.1](#).

The semi-structured interviews were designed to build a detailed picture of the challenges knowledge workers face in creating, maintaining, organising, and retrieving from their cross-platform PIM collections. At this stage of the research, tablets were not the only platform explored, but they were considered throughout — alongside the other two focus PIM-platforms: paper and the office computer. The scope constraints of the overall project were previously discussed in [Section 1.2.2](#).

### 3.5.3 Design

The structured elements of the semi-structured interviews were designed to further explore particular elements of the findings from the questionnaire, as well as address the objectives of the pilot study. Specifically, the structured components were built around the sub-activities of PIM encapsulated by [Barreau's \(1995\)](#) conceptual model, as was outlined in [Section 2.2.3](#): acquisition of items, organisation of those items, maintenance of the collection, retrieval of items from the collection. Open-ended elements were left to the essentials necessary to serve the objectives ([Lazar et al., 2010](#)).

Largely inspired by the pioneering study of office organization conducted by [Malone \(1983\)](#) the prompting questions in the semi-structured interviews included a request for a tour of the office. The request for a tour of the office was such that the researcher could query regarding the reasons for the location of a particular piece of information, and ask the participant about the storage means, acquisition means and nature of a variety of pieces of information and documents in the office. This "tour" technique is often used in HCI- and PIM-related research ([Kwasnik, 1989](#); [Zhang and Twidale, 2010](#); [Thomson, 2012b](#)).

Examples of the focus questions used for the semi-structured interviews, including a request for a tour, are shown here in the context of the sub-activity of PIM they relate to:

1. Acquisition: *"Could you please lead a brief guided tour of your office environment and indicate how information typically arrives in (and leaves) your PIM ecosystem, and anything you feel is relevant?"*



2. Organisation: *"How do you organise your information to prevent it from piling up and becoming disorganised?"*
3. Maintenance: *"What sort of meta-data do you apply, or use, to maintain your information collection?"*
4. Retrieval: *"Imagine you need to find an information item, but cannot find it. What kinds of things do you remember about it while you are looking for it?"*
5. Retrieval: *"Could you please find a specific piece of information while the researcher observes (for example, the most recent set of notes from a meeting you attended)?"*

Participants were asked, broadly, what problems they encountered with each focus PIM-platform, and the PIM-tools that they used with it. A segment of the reference sheet utilised by the researcher while conducting semi-structured interviews for the pilot study is shown in [Figure 3.15](#).

- An overview of the purpose of the research, the context of this phase and component of the research, intended uses for the interview data, confidentiality procedures and the like will be provided to/discussed with the interviewee.
- The Information Sheet and Consent Form will be provided to the interviewee, and they will be given time to read it, ask any questions they have, and then asked to sign it if they give their consent to participate. All interviewees will have already been provided with a PDF copy of these several days prior to meeting in person to conduct the interview.
- If they do not agree, the interview will conclude.
- After receiving the signed Consent Form from the interviewee, they will be asked if they're comfortable with the interview being audio recorded. If they are, the audio recording will be started. Hand written notes from the interviewer will always be taken regardless of whether the audio is recorded.
- Some initial Background Questions (as provided above) will be asked. In addition to providing relevant information, these questions will serve to warm up the interviewee, as they're easy to answer and allow them to ease into a discussion/question answering mindset.
- The semi-structured interview will now commence, likely starting with some of the Questions (as provided above), before easing into a general discussion/exploration of the

**Figure 3.15:** A segment of the reference sheet used for conducting the semi-structured interviews

During the guided tour, mentioned above, participants were queried about their PIM practices for each of the focus PIM-platforms: tablet, primary office computer, and paper documents. Queries inspired by the style of [De Leon and Cohen's \(2005\)](#) "object probes" technique were used and participants were invited to showcase the information-related features of their environment. The variety of collections of personal information maintained on each platform was surveyed, with a focus on the



PIM-tools identified in [Section 3.4.2](#). Discussion ranged from the document file organisation structures used on the office computer, to the structure and composition of paper document piles on the desk, to the specific use and information items contained with software PIM-tools used on the iPad and the computer, to email.

Each semi-structured interview lasted between 1 and 2 hours, and was carried out in the usual workspace of the interviewee, where it was possible to view the participant's activities in context and in line with the scope discussed earlier. The researcher spent the equivalent of two months full time conducting the semi-structured interviews for the pilot study.

### 3.5.4 Participation

As noted in [Section 3.3.4](#), the semi-structured interviews were conducted with a subset of the participants from the online questionnaire who agreed to participate in the follow-up. Participants were, consequently, knowledge workers at numerous local companies, startups, universities, legal and financial institutions and multinational corporations. Participants were asked not to change their collections in any other way (i.e. no tidying up!) This proved to be judicious, with a number of participants making comments similar to this quote, from one participant:

*"I would have cleaned things up and pretended it was all very orderly for you if you hadn't been very specific not to. I feel like it's all so disorganised."*

Due to the highly personal nature of PIM, a number of privacy-related precautions were employed. Past research has suggested that individuals frequently feel a sense of guilt towards a messy workspace, whether physical or digital ([Malone, 1983](#); [Bellotti and Smith, 2000](#); [Boardman, 2004](#)). Therefore, a primary concern in the study was to not cause the participants to feel uncomfortable. Participants were aware of the nature of the study in advance of the semi-structured interview and were able to remove any items they did not want the researcher to encounter (e.g. confidential information, medical reports, etc.) Interviewer exposure to content of specific items of personal information was avoided whenever possible.

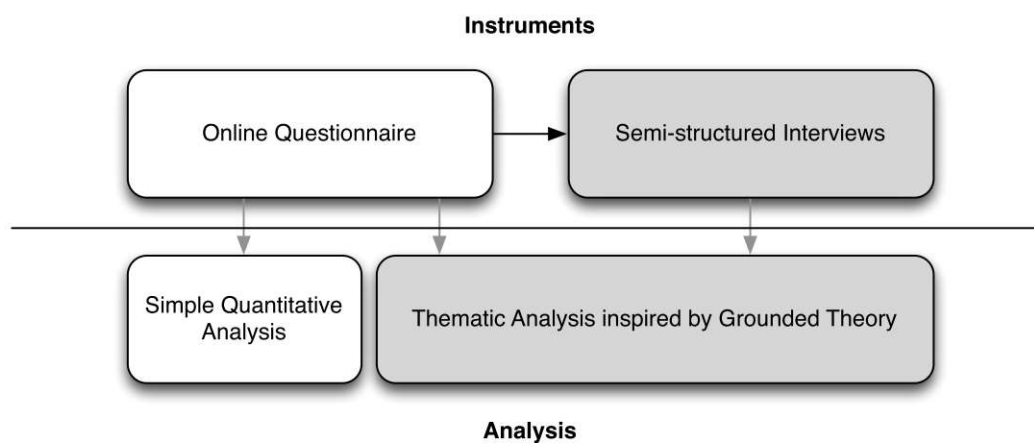
Additionally, prior to each interview the interviewer stated the participant's personal approach to managing information was not being evaluated in any way, and all participants signed a release form acknowledging that the data would be anonymised before analysis and publication. Basic demographic information was collected from all participants.

A number of individuals known to the researcher participated in the pilot study (as a whole). Care was taken to ensure existing relationships did not bias the data,

which was anonymised prior to analysis. It was envisaged that such familiarity would establish a trust basis, leading to the ability to raise concerns that may arise at any time. Participants' comments suggest that this may have been an unnecessary consideration, with many participants commenting that they felt "*liberated*" to have a chance to talk about their PIM with anyone at all. No material incentive, financial or otherwise, was offered in return for participation in the study.

### 3.5.5 Analysis

The same thematic analysis approach to that used for the qualitative analysis of the data from the online questionnaire was used for the semi-structured interview component. The phases of analysis re-used were: Data Familiarisation, Initial Coding, Initial Theming, Theme Refinement, Theme Finalisation, Final Analysis.



**Figure 3.16:** *The analysis techniques used for the semi-structured interview component of the pilot study*

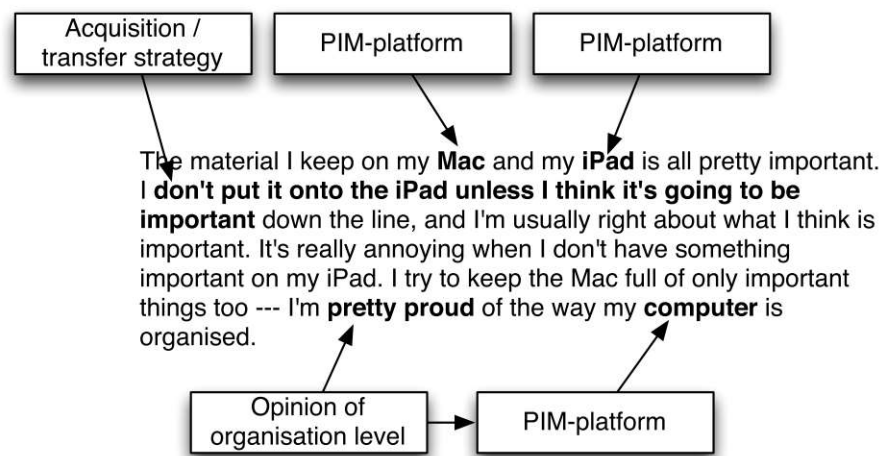
This thematic analysis technique was discussed in detail in [Section 3.3.5.1](#). [Figure 3.16](#) illustrates the analysis technique in context. In the remainder of this section, the codes and themes developed from the semi-structured interview data are presented.

**Data Familiarisation** The repeated review of the raw data from the semi-structured interviews ensured that the researcher was comfortable with the material. As before, a significant collection of notes was made during the familiarisation, but no actual coding was conducted in this phase.

**Initial Coding** The first coding phase involved identifying the interesting features of the semi-structured interview data. Again, to demonstrate the initial coding process, a participant quote is presented:

*"The material I keep on my Mac and my iPad is all pretty important. I don't put it onto the iPad unless I think it's going to be important down the line, and I'm usually right about what I think is important. It's really annoying when I don't have something important on my iPad. I try to keep the Mac full of only important things too —I'm pretty proud of the way my computer is organised."*

In Figure 3.17, the same quote with the very first iteration of coding applied to it is shown.



**Figure 3.17:** An extract of semi-structured interview data, with initial codes applied

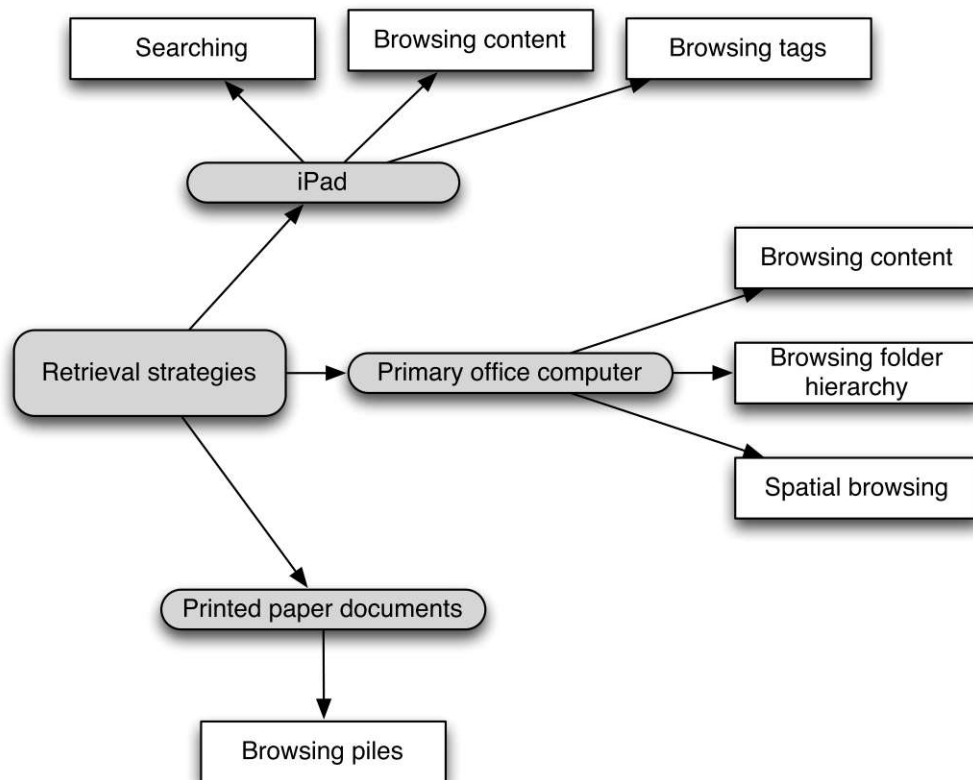
Again, a wide range of codes were developed during this initial coding phase. It is important to note that the thematic analysis of the semi-structured interview data took place separately to that for the online questionnaire data. While many of the codes identified were the same, the analysis was not approached with a preconceived intention to do so, and no codes were deliberately utilised again. This is a common occurrence as a result of thematic analyses on related data-sets. The core of the codes identified in this initial coding phase were:

- PIM-platforms
- PIM-tools
- Transfer techniques
- Re-contextualising techniques
- User experience problems
- Acquisition strategies



- Organisation strategies
- Maintenance strategies
- Retrieval strategies

**Initial Theming** The process of theming began by sorting the codes into themes, along with relevant snippets of the data. The thematic maps developed here were particularly interesting, as they allowed for an initial perspective on the deeper view of the data that was emerging.



**Figure 3.18:** An example of one of the initial thematic maps developed from the semi-structured interview data

An example of one of the initial thematic maps developed from the semi-structured interview data is shown in [Figure 3.18](#). The core themes of the research were clearly taking shape in this map, and the relationship between those themes was becoming apparent. Examples of central themes that were identified during the initial theming stage of the semi-structured interview data analysis were:

- acquisition strategies

- organisation strategies
- maintenance strategies
- retrieval strategies
- cross-platform transfer strategies
- cross-platform contextualisation strategies

**Theme Refinement** Refining the themes and codes identified from the semi-structured interview data involved merging themes together, splitting themes apart, purging themes that did not have sufficient data and generally focusing the analysis upon the core features of the data.

**Theme Finalisation** As with the earlier thematic analysis of the online questionnaire data, the advice of [Braun and Clarke \(2006\)](#) was closely followed during the finalisation of the themes: the themes were carefully focused on the data, ensuring that no theme was too wide ranging, or attempted to encompass too much of the data. A variety of coded snippets from the data were identified in order to illustrate the narrative of the data. At this stage, a description of each theme was also written.

**Final Analysis** As the final narrative formed, the data was related back to the objectives of the study. The results identified through this thematic analysis are presented below, in [Section 3.6](#).

## 3.6 Findings

This section details the findings of both components of the pilot study, concluding with a summary of the key points. Fortunately, for both components of the pilot study, participants appeared highly motivated to talk about PIM, an observation echoing that of past studies such as [Boardman \(2004\)](#), [Henderson \(2009a\)](#), and [Thomson \(2012b\)](#). That PIM, and particularly use of the tablet for PIM, appeared so important and interesting to participants did much to strengthen the researcher's resolve, validating the problem-space as compelling and worthy of the time spent investigating it. One semi-structured interview participant succinctly summed up their thoughts on cross-platform PIM, and their tablet, neatly reinforcing the goal of this research:

*"There are so many other places I need to get information to and from the iPad that it's quite a nightmare to manage my stuff these days. I tend to just take it in my*

*stride, but it feels like it should be so much easier, there's so many challenges to this stuff. The iPad has totally revolutionised the way I do my job, but it makes me more stressed and confused about the management of the information I need to work than ever before. I take it everywhere, but I feel like I have to think about it all the time. It's a perfect storm of stress and usefulness!"*

The data from the online questionnaire and semi-structured interviews allowed for the identification of a number of particular facets and challenges of cross-platform PIM, with a focus on the tablet. These facets were identified through an iterative review of the codes and themes developed during analysis with an eye towards identifying elements of the data related to each of the sub-activities of Barreau's (1995) conceptual model of PIM: acquisition, organisation, maintenance, and retrieval. The most prevalent themes of cross-platform PIM with tablets, suggested by the data, are:

- *transferring information* from other PIM-platforms to the tablet;
- *maintaining context* on the tablet when working with documents recently used on another PIM-platform;
- *maintaining organisation* for effective refinding and retrieval with information stored on the tablet;
- the use of the tablet for *micronotes*, supplanting *paper*, whilst using *more paper alongside the tablet* for other purposes.

The remainder of this section, reporting the findings of the pilot study, is structured as follows:

- [Section 3.6.1](#) reports on the participants of the pilot study;
- [Section 3.6.2](#) sets the scene, using Barreau's (1995) as a lens, by exploring the facets of cross-platform PIM;
- [Section 3.6.3](#) then discusses the challenges inherent to transferring information from between PIM-platforms;
- [Section 3.6.4](#) presents the challenges of maintaining context between PIM-platforms, with a focus on tablets;
- [Section 3.6.5](#) reviews the problems encountered maintaining organisation with information stored in PIM-tools in a cross-platform environment, with a focus on tablets;



- [Section 3.6.6](#) then discusses the use of the tablet for micronotes, supplanting paper in ways whilst supporting it in others;
- [Section 3.7](#) then summarises the findings and concludes the chapter.

### 3.6.1 Participants

Participation in both components of the pilot study was strong. There were 507 participants in the online questionnaire component and 96 participants in semi-structured interview component. Details of the online questionnaire participants were presented in [Section 3.4.1](#) and details of the semi-structured interview participants were presented in [Section 3.5.4](#).

Since a core parameter of the overall research project was to explore the PIM of knowledge workers, it is important to reiterate that 100% of the participants fit the definition of knowledge worker that was noted in [Chapter 2](#). A full list of professions who participated in the semi-structured interviews is presented in [Table 3.3](#).

Profession	Count
Aeronautical Engineer	4
Architect	7
CEO	14
Criminal Lawyer	26
Doctor (General Practitioner)	9
Financial Planner	5
High School Principal	2
Pharmaceutical Engineer	3
Software Engineer	12
University Professor	7
Urban Planner	7

**Table 3.3:** *Professions participating in the semi-structured interviews [n=96], illustrating that 100% of the participants were employed within the definition of knowledge worker noted in [Chapter 2](#)*

100% of the semi-structured interview participants were iPad users. As noted earlier, in [Section 3.4.2.1](#), given the current marketshare of the Apple iPad, and since the semi-structured interview participants were entirely a subset of online questionnaire participants, this is unsurprising. A recent Pew Internet study suggested that 31% of adults in the United States owned a tablet computer ([Pew Research Centre, 2013](#)). Participants for the semi-structured interview component of this phase were not approached based on their use of an iPad, with the 100% usage rate being a fortuitous coincidence in the sample.

It is acknowledged that the study participants are not necessarily a representative sample of the general population of users, and thus are not statistically significant.

The results should be interpreted as suggestive, rather than providing conclusive findings: they form a basis for future components of this research. The set of participants matches the purposes of the study well, establishing a picture of cross-platform PIM practices involving tablets.

### 3.6.2 PIM activities

To set the scene for a discussion of the key findings, this section uses Barreau's (1995) conceptual model of PIM as a lens through which the behaviours of participants for each PIM-platform are discussed. The PIM-platforms discussed were identified as focal points for the research in Section 3.4: the PIM-platforms discussed are the tablet, the office computer, paper documents.

The conceptual model used for discussion was first discussed in Chapter 2. Barreau's (1995) model consists of the following four sub-activities, collectively defining one viewpoint on the process of PIM:

1. *acquisition* —the activity of determining or deciding which items of information will be added, or kept, in the information space; this includes applying initial labels, groupings, or similar;
2. *organisation* —the activity of classifying or naming items of information, grouping them, and placing them in specific locations within the PIM-tool;
3. *maintenance* —the activity of updating, moving, removing and, to some extent, reorganising, items of information;
4. *retrieval* —the activity of locating items of information for reuse, disposal, or similar.

It is important to note that whilst Barreau's (1995) model treats PIM as a monolithic system centred around a file hierarchy, it has been shown to be a valid model for conceptualising various kinds of PIM (Boardman, 2004; Jones, 2012). Each of the following four sections —Section 3.6.2.1 to Section 3.6.2.4 —discusses the behaviour of participants in the pilot study, with reference to each of these PIM sub-activities for each of the PIM-platforms identified in Section 3.4. A particular focus is taken on PIM activities conducted across the platforms (cross-platform PIM) and related to the tablet.

#### 3.6.2.1 Acquisition

Acquisition, the first stage of Barreau's (1995) PIM model, involves the decision process behind what information entities get included in a particular PIM system. The

general characteristics of acquisition, for each PIM-platform, that were observed through the semi-structured interviews are:

- *tablet* —the majority of the information utilised on a tablet typically made its way to the tablet through an explicit action of the participants.

The most common means of acquisition on the tablet involved the use of emails sent by the participant to themselves, often containing an attachment, the use of web services, such as Dropbox and Google Drive, the use of the tablet camera to capture physical information, and the creation of brand new information items directly on the tablet.

- *office computers* —in contrast with the tablet, it appears as though the majority of information that was made use of using the primary office computer entered the platform through the actions of others.

The most common means of acquisition for the office computer were emails from others, download of files from the Internet, the creation of brand new information items, and physical scanned documents.

- *paper documents* —information acquisition for printed paper documents appeared to be evenly split between explicit activities of the participants and the activities of others.

The most common means of acquisition for paper documents were through an explicit print action from a computer by the participant or through a document or set of documents that was physically delivered to the participants office.

Participants appeared to place different values upon the collections contained within each of the three PIM-platforms. For example, the collection of printed paper documents was not considered important by the majority of participants, echoed in this quote from P17 of the semi-structured interviews:

*"Oh, the paper in my office isn't really important, it's not like any of it can't be recreated from something on my computer or my iPad. I prefer to chuck it away as quickly as possible. I don't find it useful for long."*

There is a strong contrast between the sentiment regarding paper documents and with the overwhelming sentiment participants gave regarding their PIM items stored within the other two platforms: tablet and office computer. The following quote is from P62 of the semi-structured interviews:

*"The material I keep on my Mac and my iPad is all pretty important. I don't put it onto the iPad unless I think it's going to be important down the line, and I'm*



*usually right about what I think is important. It's really annoying when I don't have something important on my iPad. I try to keep the Mac full of only important things too —I'm pretty proud of the way my computer is organised."*

The implications of these findings are varied, but at this point the following initial observations are made regarding cross-platform PIM, the office computer, paper documents, and the tablet:

- the majority of information "acquired" on the tablet is not created by participants on the tablet, but rather transferred there from another PIM-platform, for future use on the tablet;
- it could be suggested that *not having acquired* —or transferred —is the biggest challenge of acquiring —participants often observed that it caused a problem, or stress, if they expected to have something present in a specific PIM-platform, but did not. Most participants observed that this was because in most cases they had neglected to transfer it to that platform from another;
- other than email, most information in specific PIM-tools is explicitly acquired or created by participants.

The two fundamental styles that were observed line up with observations made in past research regarding modes of acquisition. [Boardman \(2004\)](#), specifically, discussed implicit and explicit PIM acquisition:

- *implicit acquisition* —the onus is on the individual to assess the value of independently arriving items of information —email, for example —and they must decide how to organise, maintain, or delete, the individual items;
- *explicit acquisition* —the individual, rather straightforwardly, deliberately decides what, and when, to add something to a collection -- a collection of notes inside the Notes application, for example.

However, the data from the pilot studies suggests that something more nuanced is occurring. Participants frequently remarked along the lines of this comment, from P92:

*"If I copy a file to my iPad via emailing it to myself I know that it's there, but I don't really look into it until I decide I need it. Likewise, if I receive an email from someone else containing a file, I don't really open the file until I decide I need to look at it."*

Comments like this suggest that individuals treat the activity of acquisition in a more complex manner than certain PIM models suggest. An item of information is therefore typically *received* into a PIM-platform before it is *acquired*. The observation that through the lens of Barreau's (1995) model *acquisition* can sometimes be a separate act to *receiving* is intriguing.

This observation can be validated via participant comments throughout the semi-structured interviews. P19 observed:

*"Putting something, a piece of info, on my iPad, or on my computer, or onto a piece of paper, is definitely very different from, well, accepting that information into my collection on that device, or in my collection of paper on the desk. Very different."*

Across all PIM-platforms, a significant number of participants reported concern over the acquisition of duplicate items; most of these participants expressed annoyance and concern that the software PIM-tools that they used were unable to identify and filter duplicates. Participants noted that they often copied multiple copies of things into these tools, since they were frequently unsure whether they had already done so and needed to make sure the information was available on other platforms.

### 3.6.2.2 Organisation

The second stage of the PIM model, organisation, involves the classifying, naming and grouping of items (Barreau and Nardi, 1995; Barreau, 1995). Organisation on each of the PIM-platforms was handled by participants quite differently:

- *tablet* —information stored on the tablet was rarely organised in any significant way at all.

Participants uniformly observed, and demonstrated, that their tablets were home to many hundreds, often thousands, of items of information, spread across a variety of PIM-tools and stored with little organisation scheme beyond an occasional title.

It is important to note that, unlike traditional computers, the tablet does not offer a hierarchical folder structure and whilst some specific software PIM-tools offer one, participants largely reported using software PIM-tools that did not. Participants discussed, at length, their frustrations related to the tagging of information in tablet PIM-tools, with the majority reporting that they did not tag, did not enjoy tagging, and found tagging frustrating. The majority of participants explicitly noted that they did not want a hierarchical folder structure, or similar, however.



- *office computer* —surprisingly, given the observation that most participants acquired information into their computer through the actions of others, the majority of participants reported that their computers were well organised.

Folders were the primary organisational container for all PIM-tools, including email and document files, and most commented that they performed the organisation upon the arrival, or creation, of the information item. The use of a hierarchical folder structure for document storage on traditional computers is a well-studied area (Jones, 2012, 2013).

- *paper documents* —paper documents were reported as being disorganised, but not spectacularly so.

It appeared that the length of time that participants kept paper documents was not long, therefore their collections were quite ephemeral. Because of this, they tended to be clusted in loosely contextual piles around the workspace (Buttfield-Addison et al., 2009).

Echoing the past studies of PIM reported on in Chapter 2, it was observed that the most dominant organisation mechanism employed by participants was a folder hierarchy. That said, the lack of organisation as a whole was fairly astounding, and the use of a folder hierarchy typically only applied to the office computer. Participant comments can help shed some light on this phenomena. The below comment is from P7 from the semi-structured interviews:

*"I don't bother filing [organising]. I don't bother filing on my iPad, on my computer, or even in the office really —the office is maybe the place that I come the closest to actual filing."*

Another participant, P53 from the semi-structured interviews observed:

*"I guess I could go through and move things around or put stuff in folders or tag it, or some bullshit, but I really don't see the point. It doesn't feel like that stuff will help me keep my office in order. My iPad and computer manage fine without me trying to organise, and my desk just gets the papers regularly dumped in the rubbish."*

The data suggests three high-level attitudes to organising amongst participants in relation the tablet and the other platforms:

1. *Unorganised tablet, folder hierarchy on computer, minimally organised paper documents* —by far the most predominantly observed organising strategy, participants exhibiting this strategy did little to organise the contents of their tablet, had a tight



but very simple organising strategy based on a folder hierarchy within their office computer, and created piles of recently used, or time sensitive, paper documents around their desk.

2. *Careful titling of tablet information, otherwise unorganised, folder hierarchy on computer, minimally organised paper documents* — a large number of participants reported that they carefully ensured that information on their tablet always had a title, and otherwise organised their computer and paper similarly to participants with the above attitude.
3. *Tagged information on the tablet, with a minimal folder structure where possible, folder hierarchy on computer, and minimally organised paper documents* — a smaller but still significant portion of participants reported maintaining a tagging system for information stored on their tablet. They were similar to the previous two attitudes when it came to organising their computer and paper documents.

It is acknowledged that these attitudes could be further atomised into sub-attitudes; however, it was felt that structuring the findings around high-level groupings was a more worthwhile expenditure of time. The additional detail that would have been gained by taking a more fine-grained approach to categorising participant attitudes and approaches was not necessary to address the objectives of the present study.

As with the acquisition sub-activity of PIM, participants expressed concern over the inability of software PIM-tools to identify and prevent them from storing duplicates in their collections. A vast number of participants reported challenges organising their collections arose due to duplicate copies of documents "*floating around*" (P72) in their software PIM-tools.

### 3.6.2.3 Maintenance

The third sub-activity of PIM involves the updating, moving, and removing of information (Barreau, 1995). Maintenance was acknowledged as an important factor in their PIM by almost all participants; however, every single participant also acknowledged that they believed they did not dedicate enough time towards maintenance of their PIM-platforms, with the notable exception of paper documents. With the exception of the observations regarding paper documents, this echoes the findings of many past studies, including Barreau (1995) and Boardman (2004).

Maintenance, perhaps, showcased the most difference between the PIM-platforms:

- *tablet* — participants uniformly reported that they "*never*" deleted anything from their tablet, but all reported struggling to get and keep relevant or useful PIM items on their tablet from other PIM-platforms, such as their office computer.

- *office computer* —participants, in this case, reported frequently deleting documents and emails on their computer, and many commented that it was hard to organise the contents of their computer in relation to what they did with PIM-items from the computer. For example, if they printed a document from their computer, for referencing during a meeting, they did not know how they should treat the equivalent file on the computer, following the printing.
- *paper documents* —every single participant reported that they frequently maintained their collection of paper documents by throwing various components of it away.

The overall participant sentiment towards maintenance for the entire study is embodied in the following comments, all from P28 of the semi-structured interviews:

*"Maintaining all the stuff I need to get my job done is a terrible chore, and I really don't feel like I'm on top of it at all."*

*"I don't ever delete content from my iPad, I just hoard it all there. This is really annoying, because I also have no idea what, when, or how to copy versions of information from my iPad to my computer in any sort of useful way. I always delete files and emails and whatnot on my computer, but I don't really know where to put files if I've printed them and I'm not sure when I'll need the file again or something."*

*"Printed documents? I throw them all away weekly, or so. I can't stand having them floating around my desk as piles of rubbish."*

Again reinforcing the findings of past PIM research, these findings suggest that while maintenance is actually performed by most individuals, it is done in response to clutter forming, or a general lack of space, rather than an underlying desire to maintain the PIM-collection ([Barreau and Nardi, 1995](#); [Boardman, 2004](#)).

The salient initial observations regarding maintenance are:

- participants rarely deleted information from their tablet, and felt like they frequently did not have information they needed, usually information that was on another PIM-platform, on the tablet;
- participants felt highly in control of their printed paper document collection, noting that they frequently threw the majority of their collection away after its period of use had expired;
- documents that were printed by users were a source of stress, often because users felt they did not know what to do with the digital counterparts of documents they had printed, because they felt it was useful to refer to the digital



copy but had no effective way of flagging it as something that had been printed, or similar.

#### 3.6.2.4 Retrieval

The final PIM sub-activity, retrieval, relates to the locating of items for reuse, or removal (Barreau, 1995). Echoing the results of past PIM studies, a significant amount of consistency was observed between the PIM habits of participants' retrieval practices. Similarly in line with past observations, all participants had a strong preference to browse for information, rather than search — with the exception of the tablet, where participants reported a strong preference for searching. Participants' reported retrieval behaviour for each PIM-platforms was as follows:

- *tablet* — 95% of semi-structured interview participants reported a preference for using search to find items of interest on their tablet.

Participants usually had a specific goal in mind when seeking to retrieve something from their tablet, and sought to retrieve it in a "*just in time*" fashion. That is, if they had arrived at a meeting, they would search the tablet for the relevant meeting documents as they sat down. This would often result in stress, or disappointment, if they needed information that was not available on the tablet.

Many participants reported their first attempt to locate a document on the tablet involved searching their email client for emails they had sent to themselves (containing the information they were looking for). A number also kept lists (in a tablet software PIM-tool) of filenames of documents that they had recently printed, and would use this list to locate documents either already stored on the tablet, or in web services such as Dropbox or Google Drive.

- *primary office computer* — in line with past research, particularly into email and document management, participants reported that they preferred browsing to searching when attempting to locate files on their computer. As with past studies of desktop computers, location-based browsing for files, based on their spatial position on the computer, was common (Barreau and Nardi, 1995; Henderson, 2009a).
- *printed paper documents* — retrieval of paper documents was, overwhelmingly, conducted by "*rifling through piles*" of paper on desks and attempting, usually in vain, to find the document that was sought.

Somewhat naturally, and echoing past studies' results, retrieved information reported by participants across all three PIM-platforms was largely recently acquired



information. Participants reporting a failure to find information that they sought was discussed most frequently regarding the tablet; this was often in relation to a document that participants knew existed on another PIM-platform, but were not sure that they had copied it to their tablet. The following quote, from participant P66 of the semi-structured interviews, illustrates this:

*"I often get very, very annoyed when I cannot find something that I expect should be present on my iPad. More often than not, this happens when I print something from my computer and take it to a meeting, along with the iPad, and then go to bring it up on the iPad [via searching] but can't find it—I want to bring it up on the iPad so that I can make annotations, or email it to someone, but it so often turns out that I've forgotten to put it there, or it's buried in Dropbox and I haven't got the time to locate it."*

As noted earlier, a strong preference was observed amongst participants for using search to locate and retrieve information stored on their tablet. This behaviour is quite astounding in light of the results of past research into PIM. Overwhelmingly, search has been reported as one of the least popular information location tools for a personal collection, as was discussed in [Chapter 2](#).

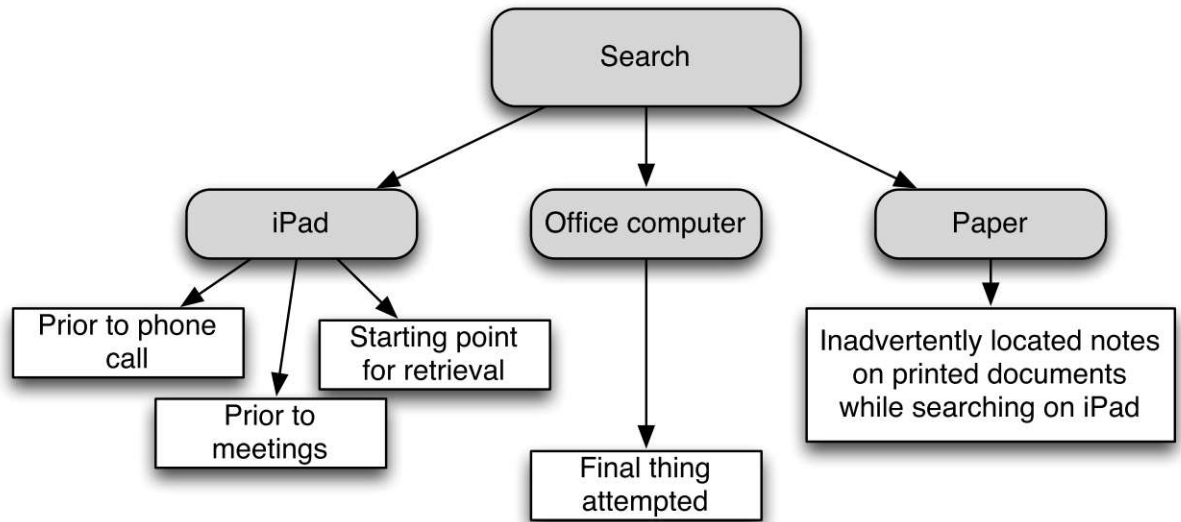
The predilection for searching reported by participants, specifically on the tablet, is highlighted in the following quote from P59 of the semi-structured interviews:

*"To find something, I start by searching on my iPad. I usually do this even if I don't necessarily expect to find it there, it's irrational I guess. I would never start by searching if I needed to find something on my computer, even though I expect the search facility is just as good."*

The data, including the codes and themes developed at various stages of the thematic analysis that was reported in [Section 3.5.5](#), was revisited in order to further explore the revelation that search appeared phenomenally popular on the tablet. [Figure 3.19](#) shows one of the thematic maps that was developed from the semi-structured interview data, regarding search.

In summarising the use of search for retrieval, the contrast between platforms can be seen:

- *on the tablet* —the first platform attempted when it was desired to locate something, often done immediately prior to a meeting;
- *on the office computer* —the final platform attempted when it was desired to locate something;



**Figure 3.19:** An example of an early thematic map regarding search for information retrieval, that was developed during the analysis of the semi-structured interview data

- *with paper* — obviously not strictly possible, however many participants reported inadvertently locating paper documents they had printed due to locating a note they had made on the tablet or computer indicating what had been printed.

### 3.6.3 Transferring Information

Barreau's (1995) model was lacking in a number of areas in terms of its ability to describe the phenomena and activities related to cross-platform PIM that were observed and reported. This section discusses one of the additional facets of cross-platform PIM that was identified through the results of this pilot study.

As was noted in Section 3.6, and as can be seen in the discussion throughout Section 3.6.2, a significant proportion of the most prevalent challenges reported by participants relate to transferring information between the PIM-platforms they used. The cross-platform nature of modern PIM appears to exacerbate this problem. The findings so far strongly reinforce that the transfer of information is a highly relevant problem for cross-platform, cross-tool PIM.

The nature of cross-platform PIM means that information must be transferred between the platforms, and sometimes between tools. Transferring information between platforms is a facet of PIM that is undertaken as part of multiple sub-activities in Barreau's (1995) conceptual model of PIM. In the context of the current study, transferring information can be considered through the lens of this model in the following ways:

- *acquisition* — acts of transfer from one PIM-platform to another could be considered *de facto* acts of acquisition, in that a new item of information is essentially created on the another platform; individuals may also simultaneously acquire or create an item on multiple platforms or tools at the same time;
- *organisation* — the naming, classification, or grouping of items can often be done by individuals for the same item on multiple PIM-platforms or software PIM-tools at the same time;
- *maintenance* — due to the storage of the same item on multiple mediums, when it comes time to remove, update, or move it around, the fact that it is stored on multiple PIM-platforms can become a problem;
- *retrieval* — the status of items stored on multiple platforms can pose a particular challenge for individuals attempting to retrieve that item for use.

This section discusses the most prevalent approaches to cross-platform information transfer that were reported by participants, and provides some initial discussion on how an understanding of these approaches might shape future cross-platform software PIM-tool design and development. Across both components of the pilot study, the most prevalent cross-platform transfer approaches reported were:

1. participants emailing themselves digital documents from one PIM-platform (i.e. the primary office computer) to another (i.e. an iPad);
2. participants taking photos of printed paper documents, using the inbuilt camera of an iPad;
3. the use of popular web services, such as Dropbox and Google Drive, to transfer digital documents between PIM-platforms.

These were identified by tallying the frequency of mentions for each strategy, across both components of the study. The specific tally for each of the above-listed transfer strategies is presented in [Table 3.4](#). Each of the most prevalent strategies used by participants to transfer information between PIM-platforms to the iPad is now discussed in detail.

Pilot study participants also overwhelmingly reported that transferring information became more complex the more PIM-platforms were involved in their daily PIM routines.



	Questionnaire	Interviews
Emailing oneself	90%	94%
Photographing paper	73%	72%
Web services	59%	61%
Manual printlog	36%	30%

**Table 3.4:** Percentages of participations who reported using each cross-platform transfer strategy [questionnaire n=507, interview n=96]

### 3.6.3.1 Emailing Oneself

The most prevalent strategy used by participants to transfer information to their iPad was email; every participant in the semi-structured interviews reported that they emailed themselves, most often from their desktop computer for later use on the iPad, in order to transfer information between PIM-platforms. Participants uniformly commented along the lines of the following:

*"Emailing stuff to myself is very useful, so I do it a lot. It's something I do daily, sometimes quite a bit. I do it for notes to myself, or I do it so I can send something I attach to the email over to the iPad for use there."*

Asked why they did this, participants typically revealed that they email to themselves to be a very straightforward means of transferring material to their iPad that would not cause their file hierarchy on their computer to become cluttered, as PIM-tools such as Dropbox or Google Drive would do:

*"I think it's the easiest way of getting my documents to the iPad without confusing everything else. If I put it in Dropbox or something, for which I have an app on my iPad, it ends up floating around my file system and I don't really know why it's there, or whether I should get rid of it when I re-encounter it in the future. When it's just in email, well email is naturally a mess already, so a few more emails floating around doesn't matter in the scheme of things."*

Discussing what happened once they received these emails on their iPad, participants typically expressed concern at the ensuing confusion that they sometimes generated when emails from others were received afterwards:

*"I must admit that it's a bit of a nightmare to find the emails I send to myself, usually if too much time passes between when I send it and when I go to find it obviously. Lots of other emails come in from other people and push my emails down, so it all just gets on top of me."*

The significant prevalence and user discussion around this cross-platform transfer technique suggested that it was necessary to follow up in future components of the research project.

### 3.6.3.2 Photos of Paper

The second most prevalent strategy used by participants to transfer information to their iPad involved the use of the inbuilt camera to take photos of paper documents. More than 80% of semi-structured interview participants reported to using the strategy, with the majority of those using it on a daily basis. Discussing their use of this strategy, participants were largely positive about it but readily admitted that they could not easily convey why they did it so often:

*"I use the iPad's camera to snap pictures of paper stuff a lot. I don't like keeping the paper around so taking a photo of it is often the best way to get rid of it. I don't know why do it beyond that though."*

Asked whether they utilised a traditional office scanner for similar reasons, or at all, most responded:

*"I do scan things but they're very different things to the sort of paper I just take a photo of. I scan full sized pieces of paper, big long documents, things like that. I use the iPad and take photos of sticky notes, brochures with annotations, random annotations I've drawn in the margins of proper documents, things like that."*

Discussing the PIM-tools they used alongside their iPad photo taking, participants expressed annoyance that most did not accommodate their needs:

*"I take the photos with the camera application that's built into the iPad, but I often put the photos I've taken into Dropbox. The annoying thing is that Dropbox doesn't have any way to recognise what I'm doing, and maybe it shouldn't, but it doesn't know that this series of photos is the back and the front of a particular document. I can't group the photos together into any sort of sensible way."*

The high prevalence reported by participants for the use of photos as a data-input method for iPad PIM suggested that following this up in later phases of this research was crucial.

### 3.6.3.3 Web Services

The use of web services for information transfer between PIM-platforms was the third most prevalent transfer strategy reported by participants. It was, however, only dis-

cussed as being used by 12 of the 96 semi-structured interview participants, and 62 of the 507 online questionnaire participants.

Across both components of the pilot study, the most frequently mentioned web services were Dropbox, Google Drive, and Evernote (Soule, 2013). Participants generally reported using all the services in the same way; Google Drive and Dropbox, particularly, since they both take the form of a folder on the hierarchical file system of the office computer. Whilst participants only reported limited use of these services for transfer, those that did discuss them provided a consistent perspective on their use:

*"I use Dropbox as kind of a backup service, I don't really use it to send things around my gadgets. I don't use it to send things to the iPad because if I put something in Dropbox it means that it's cluttering up my computer, and if it's there only to be sent to the iPad it means that I have to remember to remove it from Dropbox at some point later, and I always forget to do that, so I just don't use it for that purpose."*

This perspective was consistent across all participants who discussed using web services.

### 3.6.4 Maintaining Context

As was noted in Section 3.4.4, Barreau's (1995) model was lacking in a number of areas in terms of its ability to describe the phenomena and activities related to cross-platform PIM that were observed and reported. This section discusses another facet of cross-platform PIM that was identified through the results of this pilot study: maintaining context.

As noted in Section 3.6, and as can also be seen in the discussion throughout Section 3.6.2, a large number of the most prevalent challenges reported by participants appeared to relate to maintaining context across PIM-platforms. The following comments from P54 of semi-structured interviews, who reported a number of specific challenges related to context, provide an overview of the challenges consistent with the majority of participants who reported them:

*"It's a huge headache trying to figure out what's going on when I move from using my computer to my iPad, like when I go to a meeting or work in a different part of the building. If I've just printed something, I end up sitting in a conference room with a pile of printed papers and my iPad, and I'm not sure what's in the pile of printed things, so I often write a quick list of what I print as I print it [before leaving the office] so I can quickly figure out what's in this pile of printouts so I can use them at the meeting."*



*"If I'm reading on the computer before I head to the meeting, I then spend time in the meeting searching my emails, or searching Dropbox or something to try and find the document I was reading on the computer before I left the office. It's all a bit of a headache."*

As suggested by the above quotes, the most prevalent problems maintaining context reported by participants in both components of the pilot study were:

1. lack of context regarding documents recently printed from an office computer;
2. lack of context regarding documents recently open, or edited, on an office computer.

Participants generally felt that it was *"hard to get your head into context between devices and paper"* and that *"too much time in the workday is spent on sorting this stuff out because it seems like it should be easy"*. The two most prevalent situations reported regarding context between PIM-platforms are now discussed in [Section 3.6.4.1](#) and [Section 3.6.4.2](#). It is emphasised by the researcher that these are very similar context challenges.

#### **3.6.4.1 Printed Documents**

Participants during the semi-structured interviews discussed at length the fact that they had significant trouble identifying or remembering the context of documents that they had printed from their desktop computer. Participants of the online questionnaire component of the pilot study also noted this as a problem. The following quote, from the semi-structured interviews, illustrates the problem:

*"The collection of documents that I take with me to a meeting, stuff I've just printed in my office, ends up taking a large chunk of my meeting time as I figure out what it is that I've printed and why I needed it."*

Another participant shed light on the ways in which he used his iPad alongside paper documents:

*"I like to write notes, summarise, comment, things like that, about documents I need for work, and I like to do that on my iPad. So I usually print out the documents I want to write about and do the writeup on my iPad, but I often don't even know what the filename or context, or even the relevance of some of the things I've printed are, so I have to spend time figuring that out."*

The sentiment expressed in the above quote was expressed by 62 of the semi-structured interview participants. The use of the tablet for note-taking alongside paper documents appears common amongst pilot study participants. Asked why they

felt that this presented a problem to them, participants generally noted that they felt knowing the context for which they printed something helped them better utilise both the printed document, and any notes that they might make regarding it:

*"I think it's important for me to be able to remember why I printed something, since otherwise I get lost with my summarising and such, and it's not as useful as it would be. The context I try to remember is, well, the file name and what meeting I was heading to with the printout, most often."*

A number of participants noted that they worked around this particular challenge by making a list on the tablet of documents that they had printed from their computer, which they would use to identify the documents in the collection of printouts. A participant from the semi-structured interviews summed up this approach:

*"I make a list on the iPad, usually in the notes app, and it's basically just a list of the filenames of the documents I'm printing. I use the list to sort the printouts when I'm at the meeting."*

#### 3.6.4.2 Open Documents

The other most prevalent problem reported regarding maintaining context across multiple PIM-platforms was the challenge of switching from one's office computer to the tablet, usually for a meeting, and maintaining context with respect to the documents open on the office computer. Participants of the semi-structured interviews reported that refinding, locating, opening, and regaining context within documents that they had been reading on their computer was a particularly strong annoyance:

*"I usually read a lot of literature in preparation for a meeting, and I do that sitting at my desk using my computer, but when I go to the meeting I get distracted while I locate the material I was reading and get back up to speed and find where I was up to, so I can make a meaningful contribution to the meeting regarding the material. Because of this I often miss bits of the meeting, make myself stressed, and often I don't really have the time to actually locate what I need anyway, so I don't get it."*

This problem was reported by 40 of the semi-structured interview participants. Uniform amongst these participants was the concern that they would be unable to easily regain context when switching to their tablet after working with personal information using their office computer. As with the challenge reported regarding printed documents, a number of participants worked around this particular challenge by making a list on the iPad of the documents and context in which they had been working

with on their computer, from which they attempted to restore context when using their tablet. A participant from the semi-structured interviews sums up this approach:

*"I'll take a quick note of what I'm doing on my computer onto the iPad so I can spend a bit of time early on in the meeting when I'm sitting there with the iPad setting back up. It takes a bit of time to get that context back though."*

### 3.6.5 Maintaining Organisation

Whilst organisation, unlike transferring and context, is part of Barreau's (1995) model, this study revealed evidence of significant participant dissatisfaction with the facilities they had available for the organisation of information on their tablets. The dissatisfaction was primarily related to the user experience of many popular software PIM-tools on a variety of platforms. Echoing the results of Boardman's (2004) study and other similar studies, the vehemence of expression relating to user experience in tools mentioned by users was startling.

Participants raised a large number of concerns with the user experience of a variety of software PIM-tools. This section highlights two issues related to maintaining organisation with the tablet using common software PIM-tools that were raised most frequently by participants:

1. *tagging fatigue due to the prevalence of tagging in user interfaces* — participants overwhelmingly reported being stressed at the implication, as presented in the user interface of many software PIM-tools, that they should provide tags for their content;
2. *fragmentation due to the inability for PIM-tools to identify identical content* — participants often reported being stressed and concerned when software PIM-tools, such as Email, Evernote, Dropbox, and Google Drive, were unable to identify the fact that they had placed two identical document files within them, resulting in content being duplicated (i.e. two PDF files with the same content, synced twice).

Prevalence was established by tallying the frequency of mentions for each issue. The specific tallies for each of the above-listed issue is presented in Table 3.5. In Section 3.6.5.1 and Section 3.6.5.2, each of these user organisation challenges is discussed.

	Questionnaire	Interviews
Tagging fatigue	417	78
Fragmentation	240	71

**Table 3.5:** Tallies for each user experience problem (UXP) reported



### 3.6.5.1 Tagging Fatigue

The term "*tagging fatigue*" was coined by the researcher to describe a feeling reported by a significant percentage of participants from both the questionnaire and interview components of the pilot study. Tagging fatigue involves the feeling that various software PIM-tools, largely on the tablet, would make it challenging for to locate their information again in the future if they did not provide tags. A participant, P12, from the semi-structured interviews summarised the feelings:

*"I hate it. The UI [user interface] makes me feel like I have to tag everything, and that I won't be able to find it again if I don't, but really search just works fine without tags applied and the continual appearance of tags, or the lack thereof, in the interface just makes me feel like I have more work to do to keep things organised."*

Likewise, P14 from the semi-structured interviews suggested that tagging was too much effort, and that they were not sure if the effort it involved with result in future benefits, but were still concerned that not tagging would impact their ability to find information in the future:

*"Tagging is so much extra effort, I have to think about my note too much more, what I want to use it for in the future, things like that, that I often just don't want to tag it. I really don't care, or know, if it [tagging] will even help me find it faster in the future."*

Examples of the themes and codes ultimately associated with the theme of tagging fatigue, for both the questionnaire data and the interview data, were:

- hate/can't stand/annoyed by tagging
- annoyed by tags
- obligated to tag (by UI)
- tagging feels like work
- "too much effort"
- unsure if [tagging] useful
- "not useful for finding"
- "shit work"

417 of the 507 online questionnaire participants and 78 of the 96 semi-structured interview participants were identified, through the thematic analysis, as experiencing tagging fatigue. The feeling of tagging fatigue seems to be at odds with past scholarship regarding tagging. Relatively recent work, such as [Voit et al. \(2009\)](#), suggests that tagging is one of the most optimal solutions for organising and refinding information, for certain groups of users. Likewise, it is often suggested that tagging, which is an act of categorisation or grouping, causes an individual to put more thought into the purpose and contents of the item being tagged ([Craik and Lockhart, 1972](#); [Jones et al., 2005](#); [Civan et al., 2009](#); [Jones et al., 2012](#)).

These findings suggest that individuals are highly aware of this additional mental overhead required from tagging and —rightly, or wrongly —assume that the overhead is not worth the effort for potential benefits in future refinding. This theme relates to all the stages of the PIM model and suggests that a reappraisal of the role of tagging in, at the very least, tablet software PIM-tools, is worthwhile.

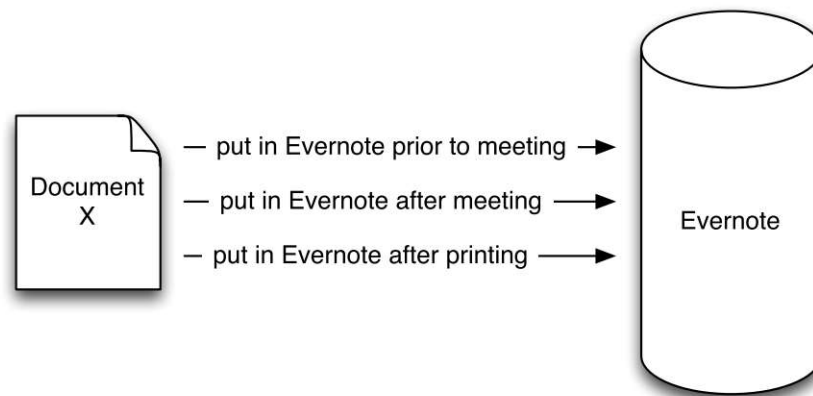
### 3.6.5.2 Fragmentation

The second most prevalent problem of maintaining organisation reported by participants in the pilot study involved a fragmentation of their collection due to the accumulation of duplicates. Participants reported being frustrated with PIM-tools that were incapable of identifying duplicate content added to their collections.

Participants reported, for example, using Drobbox to store a PDF document, and then, at some point in the future, storing the same document again in Dropbox; when they later sought to retrieve the document, they had to expend time and effort resolving whether they were any differences between the two versions of the document (when, in most cases, there were not any) and then managing their information to remove the duplicate. P82, from the semi-structured interviews, summarises the problem:

*"My iPad, and my Dropbox, are full of copies of the same sets of documents. It's absolutely ridiculous! I might put a proposal document in Dropbox one night before I leave to read over night [on the iPad], then sometime in the next few days I'll put it into Dropbox again before I go to a meeting, and then it'll be that I have two versions of the same thing and Dropbox wasn't smart enough to recognise this and tell me. Infuriating!"*

The problem is illustrated in [Figure 3.20](#). Past scholarship explored in [Chapter 2](#) has definitely explored information duplication and deduplication in PIM, but it is worth acknowledging again here, due to the significant prevalence of the issue as reported by participants of the pilot study participants.



**Figure 3.20:** Overview of the fragmentation problem in software PIM-tools (due to multiple copies of the same information) reported by participants

### 3.6.6 Paper and PIM

The way in which participants reported using paper alongside their tablets came of particular surprise to the researcher. The possibility that the tablet was supplanting the use of paper for the purpose of micronotes (Lin et al., 2004) was noted as part of the initial findings reported on in Section 3.4.3. Data collected in the second component of the pilot study continues to support this possibility.

Nearly 42% of online questionnaire participants reported, unprompted, the use of micronotes as a component of their PIM, with 76% of those also discussing the use of micronotes in the context of their tablet as being a particularly challenging aspect of PIM. This use of micronotes was determined through the identification of codes relating to the features of micronotes that were discussed in Section 2.2.3.2 and their application to the information mentioned by participants.

Data from semi-structured interviews supported this observation, with all but one of the 96 participants discussing their use of micronotes alongside the tablet and paper documents. Participants used the tablet for writing down a variety of micronotes for a range of purposes. The following selection of comments, all from one participant of the semi-structured interviews, illustrates the prevailing attitude amongst the 95 semi-structured interview participants who discussed their use of micronotes alongside the tablet and paper documents:

*"One of the huge uses of my iPad is for writing down scrappy, kind of transient bits of information that I might need sometime soon. Things like phone numbers, dates for events I need to go to, names of documents that I need to source, names of documents that I've printed so I remember why I've printed them, stuff like that."*



Participants typically did not use the "official tool" (that is, the built-in software for tasks such as calendaring or contact management) when writing down information that could be considered a micronote on the tablet:

*"Oh, and if I'm writing, like, a phone number or event down on the iPad, I write it as a note, not as a calendar item or a contact, so it's still really scrappy. I don't use the official tool for this sort of stuff."*

All participants who discussed using the tablet as a repository for micronotes commented that they formerly used paper, particularly the reverse side of printed documents and sticky notes, for their micronotes:

*"I used to use sticky notes or the reverse side of old printouts, but now it all goes on the iPad. I guess 3M should be worried!"<sup>1</sup>*

Participants all observed that the tablet was more "convenient" for micronote-style information, and that they felt that they would make better use of the information if they put it into the tablet, instead of onto paper — a number of participants commented that search, particularly, was a good reason for doing this, but all commented that it was useful to be able to "convert" or "move" it to something "more formal" or a "proper copy of it":

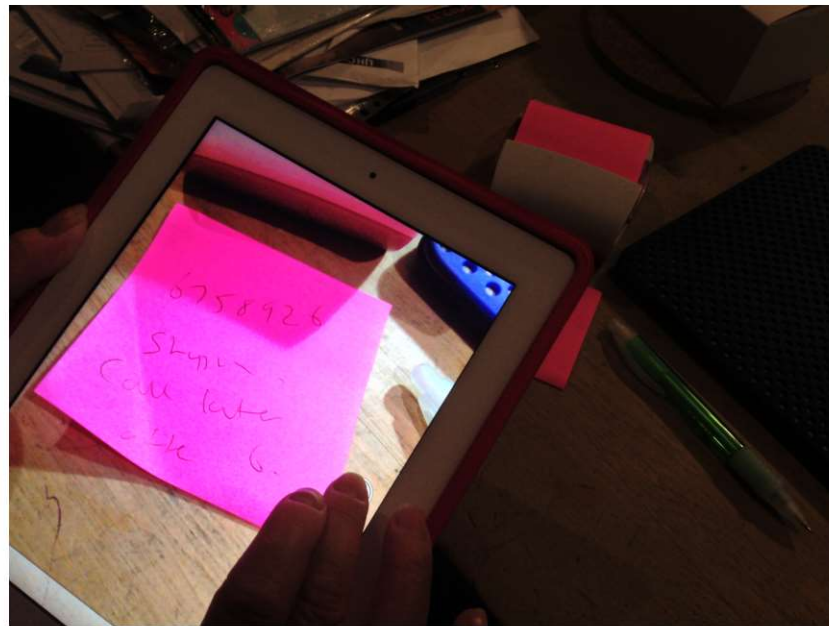
*"So yeah, I scribble numbers, events, stuff like that down still, but I do it on the iPad because it's more convenient, I guess, I feel like I'll make better use of it if I put it on the iPad instead of on some scrappy paper. I can search it there, I can convert it to something more formal there, and I don't have to recreate it too, which is useful."*

Finally, every participant who discussed micronotes during the semi-structured interviews suggested that they frequently felt like their micronotes fell "out of control" through their use of the tablet. Despite this, they all also vehemently noted that they would prefer to never stop using the tablet for micronotes:

*"I do feel like I lose control of the scrappy notes on the iPad quite often, they sort of mount up and I feel like the iPad is nothing but a repository of this junk, and it's annoying because before I started doing this junk would have gone away, because I'd have purged the scraps of paper from my desk at some point. The iPad just keeps it all and silently judges me! I wouldn't give it up for anything though [for the purposes of micronotes]."*

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<sup>1</sup>The 3M Company is the manufacturer of "Post-it" brand sticky notes: [www.3m.com/us/office/postit/](http://www.3m.com/us/office/postit/)



**Figure 3.21:** A typical activity of many semi-structured interview participants: taking photos of paper micronotes using the iPad

A number of participants made use of the tablet camera as data-input method that was discussed in [Section 3.6.3.2](#) for their micronotes: first annotating a paper document, which was often still a sticky note, with the necessary information before snapping a photo using the iPad and then disposing of the paper copy. This behaviour was reported by 26 of the semi-structured interview participants, and observed in practice in the office of 9 (a subset of the 26) during the *tour* component that was previously discussed in [Section 3.5.3](#). When asked why they conducted this practice, the 26 participants unanimously responded along the lines of this comment:

*"It's a lot more useful to have this on the iPad, but it's a lot harder to write it on the iPad. I don't see why I'd want to keep the paper about."*

The typical behaviour of these participants is illustrated in [Figure 3.21](#). This behaviour was interesting for a number of reasons — first and foremost, it could be seen as a strong indictment of the tablet's input capabilities; are both the ability to hand-write and type insufficient?

## 3.7 Conclusions

This chapter has reported on the online questionnaire and semi-structured interviews that were conducted for the pilot study phase of this research. In the pilot study, 507 participants took part in an online questionnaire designed to explore knowledge

workers' PIM in general, and 96 participants, a sub-set of the questionnaire participants, took part in semi-structured interviews to explore knowledge workers' PIM in detail, and understand the platforms used in cross-platform PIM, with a focus on the tablet.

The findings of the pilot study can be broken down into the following facets:

- confirmation that the tablet, and cross-platform PIM, are valid research angles;
- the identification of the most prevalent PIM-platforms used alongside the tablet;
- *transferring information* between PIM-platforms is a key facet of cross-platform PIM;
- *maintaining context* across PIM-platforms is a key facet of cross-platform PIM;
- the use of the tablet for *micronotes* and the *use of paper* alongside the tablet warrant further discussion;

Broadly, the pilot study has fulfilled the objectives it was designed to (as discussed in [Section 3.2.1](#)) by:

1. identifying the PIM-platforms that are most commonly used alongside the tablet;
2. observed that the tablet has a central role in many knowledge workers' PIM, thus confirming the research focus as valid;
3. provided an initial update to a scholarly understand of real-world, modern cross-platform PIM.

Similarly, in line with the objectives of the overall research that were discussed in [Section 1.2.1](#), the pilot study has:

1. successfully provided an update to the body of knowledge regarding PIM, accounting for the role of the tablet;
2. made a preliminary identification of the most prevalent challenges, across a wide range of facets and sub-activities of PIM, involving the tablet as a PIM-platform;
3. established a number of potential avenues that future software PIM-tools for the tablet, and for PIM-platforms used alongside the tablet, could account for.

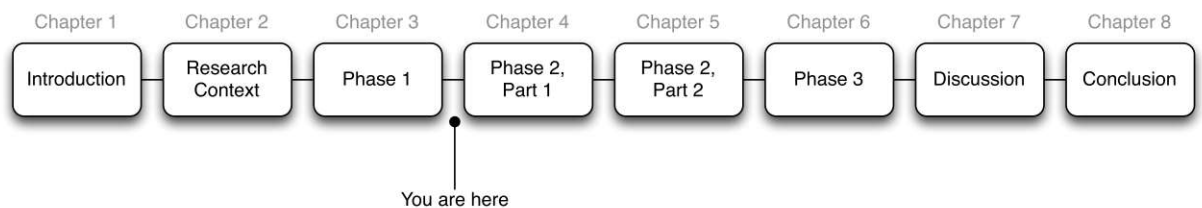


The findings around transferring information and maintaining context and organisation across PIM-tools all suggest that there are a number of significant gaps that future design work around the tablet and PIM could support. Cross-platform PIM is also not living up to the ideals presented in popular culture that were showcased in [Chapter 1!](#)

It is argued that the study reported in this chapter was successful in meeting its objectives. A wide range of findings have been presented. In addition to helping the researcher gain a foundational understanding of the research domain, a number of contributions were also made.



In the following chapter, the core facets of cross-platform PIM and the tablet identified in this chapter will be used to develop an exploratory study of the tablet's role in PIM, designed to explore the most challenging facets in detail in order to develop a conceptual model of PIM and allow for the development of prototype software PIM-tools to address the deficiencies of PIM that are identified.





*I hate the f--king iPad, it's f--king useless, and constantly f--king annoys me. But I can't get anything f--king done without the f--king thing.*

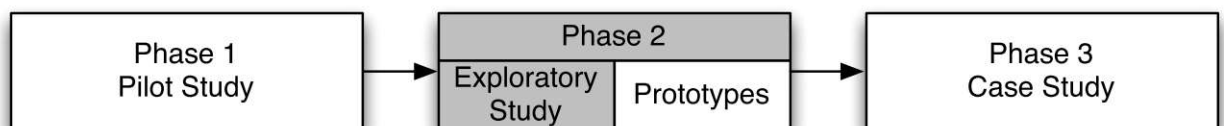
—Pilot Study Participant

# 4

## Phase 2: Part 1, Exploratory Study

**T**HIS chapter reports on an exploratory study of tablet use in cross-platform PIM, with a focus on the challenges identified during the pilot study that was reported in [Chapter 3](#).

The study was designed to build on the understanding of the tablet-related challenges, techniques, user experience, and behaviour exhibited and reported by participants in the previous study. The understanding developed through this exploratory study would then be used to drive a round of prototyping, designed to explore and validate the findings. This phase is the second of three, and the exploratory study is first part of this phase, as shown in [Figure 4.1](#).



**Figure 4.1:** Phase 2: Exploratory Study

### 4.1 Introduction

This first part of the second phase of this research, an exploratory study, was designed to explore the facets and challenges of using a tablet for PIM that were identified during the pilot study, furthering the findings of the pilot study and deepening understanding of the tablet and cross-platform PIM.



This part of the second phase, an exploratory study, had two core components, and was structurally similar in design to the pilot study. In addition to a modified line of enquiry with participants, the largest differences were the directed focus upon the tablet during both the online questionnaire and semi-structured interview components, and the approach based on grounded theory used for the analysis of the interview data. These modifications were designed to focus the study around the tablet and deepen the theory building and sense-making abilities of the analysis, respectively.

### 4.1.1 Chapter Structure

In this chapter, both components of the exploratory study are presented sequentially, followed by a discussion of the combined findings:

- [Section 4.2](#) presents the approach taken in conducting the exploratory study.
- [Section 4.3](#) reports on the first component of the study, an online questionnaire focusing on participants' use of tablets for PIM. The section reports on choice of method, participants, and data collection and analysis technique.
- [Section 4.4](#) then reports on the second component of the study, a series of semi-structured interviews regarding knowledge worker's use of tablet for cross-platform PIM. The semi-structured interviews were focused on the facets of PIM using a tablet that were identified in the pilot study: challenges, PIM techniques, and activities. The section also reports on choice of method, participants, and data collection and analysis technique.
- [Section 4.5](#) reviews the findings of the exploratory study, focusing on core facets of cross-platform PIM that were identified in the pilot study, and again in the exploratory study: transferring information and maintaining context. The use of tablets for micronotes is also discussed and explored. Initial commentary on the conceptual model of cross-platform PIM that was developed as a result of the pilot and exploratory study findings is presented.

## 4.2 Approach

Part 1 of Phase 2 was an exploratory study that focused on the tablet. The use of the term exploratory refers to the fact that the study explores the depth of a particular area ([Uma and Bougie, 2003](#); [Babbie, 2012](#)), in this case the tablet, without a specific assumption to explore. Exploratory studies are a technique used frequently in social

(Babbie, 2012) and HCI research (e.g. Birnholtz et al., 2007) with great success, despite their inductive approach being at odds with traditional scientific method (Armstrong, 1970).

Whilst the exploratory study was primarily designed to provide a detailed understanding of the use of tablets for cross-platform PIM, it also continues the process, started in the pilot study, of building a better holistic understanding of modern real-world cross-platform PIM. In doing so, it continues to address this gap in past research that was identified in Chapter 2.

The remainder of the section reviewing the approach is structured as follows:

- Section 4.2.1 discusses the specific objectives of the exploratory study;
- Section 4.2.2 lists the methods used;
- Section 4.2.3 notes ethical considerations;
- Section 4.2.4 summarises the contributions to the research made by this phase.

### 4.2.1 Objectives

The primary objective of the exploratory study was to explore the use of the tablet for PIM, using the facets and challenges of PIM identified during the pilot study to focus the study. The facets related to cross-platform PIM, which was identified as an area of focus in Chapter 3, were of particular interest.

This would be done by exploring the use of tablets by knowledge workers for PIM on a wide scale. Following this, the intricacies of the most challenging aspects of PIM and the tablet in a cross-platform environment were to be explored and unpacked.

Alongside this, the exploratory study sought to lay the empirical groundwork necessary for making some design recommendations for future tablet-based software PIM-tools and to create a conceptual model illustrating the understanding of tablet-based PIM in a cross-platform environment developed so far.

In summary, the core objectives of this iPad-focused exploratory study were:

1. *to focus on, and further explore, the facets and challenges of cross-platform PIM involving tablets that were identified in the pilot study* —the exploratory study would take the most prevalent challenges and facets of cross-platform PIM that were identified in the pilot study and further explore them, working to understand how and why they occur.
2. *to build the empirical groundwork necessary to begin making recommendations for the construction of prototype software PIM-tools* —as one of the objectives of the research



was the construction of software PIM-tool prototypes, the exploratory study would further build the empirical groundwork necessary by identifying the most suitable challenges for prototypes to address.

3. *to provide the basis for an initial exploration of a conceptual model of cross-platform PIM, using tablets as an exemplar platform* —in service of the overall research objective to describe a conceptual model as a means for discussing cross-platform PIM, the exploratory study would identify the facets of cross-platform PIM that should be included in such a model.

### 4.2.2 Method

To address these objectives, the exploratory study made use of the same two data collection tools as the pilot study: an online questionnaire and semi-structured interviews. These two components were again conducted sequentially, with the results of the online questionnaire again driving the conduct of the semi-structured interviews. As noted in [Section 4.1](#), the design and objectives of these tools was quite different to the pilot study.

As was discussed in [Section 2.3.1](#), questionnaires and interviews are respected and widely used tools for data collection in similar research. It is important to note that the design of the online questionnaire and semi-structured interviews used in this exploratory study was distinct from the tools used for the pilot study. The specific procedures used for these exploratory study questionnaires and interviews are discussed in [Section 4.3](#) and [Section 4.4](#) respectively.

Analysis for the online questionnaire data was conducted using the thematic analysis technique used for the pilot study, as reported in [Section 3.3.5](#). Analysis for the semi-structured interviews took a more formal approach, based on grounded theory methods and is reported in [Section 4.4.5](#).

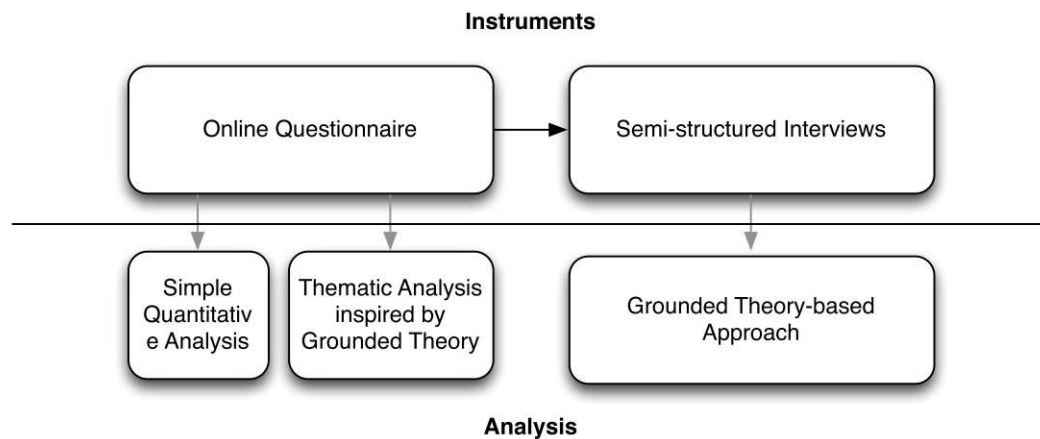
Following on from the observations regarding user-centred design (UCD) methodologies in [Chapter 2](#), this chapter reports further on the first part of what is, essentially, an implementation of a UCD methodology. Seen as a UCD-inspired methodology ([Harrison et al., 2010](#)), the stages employed are:

1. *Gathering of requirements* —the exploratory study reported on in this chapter constitutes a further requirements gathering phase, empirically grounding the later parts;
2. *Design and implementation* —the design work and prototypes reported on in the following chapter, [Chapter 5](#), is motivated by the results of this exploratory study;



3. *Evaluation* — a core, but not singular, component of the case study reported on in [Chapter 6](#) is the evaluation of the prototypes.

It is important to note that this study is not a UCD-study, but it does use many of the methodologies and techniques present in such a study.



**Figure 4.2:** *The tools and analysis techniques used in the exploratory study*

A visual overview of the methods of the exploratory study is shown in [Figure 4.2](#).

### 4.2.3 Ethics

Both the online questionnaires (H0012535) and semi-structured interviews (H0012713) reported on in this chapter were approved as Minimal Risk Studies by the Tasmanian Research Ethics Committee.

Additionally, a number of precautions to data handling, procedure and analysis were taken — this was due to the potentially private and sensitive nature of participants' personal information. Precautions taken included:

- participants were not required, at any time, to discuss or show — even in passing — an item of personal information that they could not, or did not feel comfortable involving in the study;
- participants were free, at any time prior to the collection of data from them being completed, to withdraw completely from the study;
- participants were comprehensively informed that no judgements were being made by the researcher upon their organisational skill (or lack of).

#### 4.2.4 Contributions

This chapter makes the following contributions to the thesis:

1. Expanded discussion of the facets of cross-platform PIM both in general and related to the tablet, focusing on the techniques used, and challenges faced by knowledge workers in conducting their PIM;
2. Initial data on the requirements of software PIM-tool design to support cross-platform PIM;
3. New insight into the use of the tablet for micronotes and its subsumption of paper;
4. An initial perspective on a conceptual model of cross-platform PIM, using the tablet as a case study.

Components of the work discussed in this chapter were reported in a previous publication ([Buttfield-Addison et al., 2013](#)).

### 4.3 Online Questionnaire

The first component of the exploratory study reported on in this chapter was an online questionnaire. Following from Phase 1, as discussed in [Chapter 3](#), this study utilised the same tools for data collection, but with a different implementation.

The objectives of Phase 2 meant for a deeper focus on the tablet, and the intricacies, challenges and strategies particular to it. The goal of the questionnaire was, therefore, to collect additional data regarding a number of specific facets and challenges of PIM involving the tablet that were identified during the pilot study.

The questionnaire was conceived as a way to further explore the points of interest regarding the tablet that were identified in the pilot study. By using the questionnaire as the first component of this exploratory study, before moving to semi-structured interviews to go even deeper, additional focus was able to be developed ([Lazar et al., 2010](#)). Materials from the online questionnaire are included in <http://paris.id.au/>

The remainder of this section, exploring the decisions behind, scope, design, and analysis of the online questionnaire, is structured as follows:

- [Section 4.3.1](#) discusses the choice of methodology;
- [Section 4.3.2](#) discusses the scope of the questionnaire;
- [Section 4.3.3](#) discusses the design of the questionnaire;

- [Section 4.3.4](#) discusses recruitment and participation for the questionnaire;
- [Section 4.3.5](#) discusses the analysis techniques used for the questionnaire data.

### 4.3.1 Choice of Methodology

As with the pilot study, a questionnaire was selected as the first component of the exploratory study. Questionnaires are an established data collection instrument for PIM studies and excel at establishing a detailed snapshot of participant behaviours, needs, and experiences ([Kjeldskov and Graham, 2003](#)).

In the context of this exploratory study of the tablet, the questionnaire allowed the researcher to build a detailed picture of the role of the tablet in cross-platform through a series of focused questions, before proceeding to the semi-structured interviews; the focus of the semi-structured interviews was thereby increased ([Lazar et al., 2010](#)).

A discussion around the reasons for choosing an online questionnaire for this sort of research was previously presented in [Section 3.3.1](#) as part of the pilot study. [Section 2.3.1](#) also discussed the use of questionnaires for data collection.

### 4.3.2 Scope

The scope for the online questionnaire component of the exploratory study was quite straightforward: to rapidly develop the picture of the nature, role of, and problems inherent to using the tablet in cross-platform PIM, using the challenges identified in Phase 1 (as reported in [Chapter 3](#)) as the focus of the questions. The scope constraints of the overall project were previously discussed in [Section 1.2.1](#).

### 4.3.3 Design

As with the questionnaire used for the pilot study and discussed in [Section 3.3](#), standard techniques for questionnaire development were followed, allowing participants to be able to answer broadly, without forcing themselves into answers that were implied by the question ([Sue and Ritter, 2011](#)). The questionnaire was again designed and implemented as a website using the popular questionnaire-tool *SurveyMonkey*. An example of the format that the questionnaire was distributed in is shown in [Figure 4.3](#).

Again, there was little in the way of preformulated hypotheses. The questions were, however, focused upon the tablet. Examples of the questions used in this online questionnaire include:

1. How long have you used a tablet computer?
2. For work purposes, how do you use the tablet computer?



The screenshot shows a web browser window with the title "Exploring the use of iPads for Personal Information Management Survey". The address bar shows the URL "https://www.surveymonkey.com/s.aspx?sm=n". The survey interface has a dark blue header with the title and an "Exit this survey" button. Below the header is a progress bar. The main content area contains three questions:

**3. How long have you used an iPad-style tablet computer?**

- ☐ More than 2 years
- ☐ Between 1.5 and 2 years
- ☐ More than 1 year
- ☐ Between 6 months and 1 year
- ☐ Between 3 months and 6 months
- ☐ Under 3 months

**4. How often do you use an iPad-style tablet computer?**

	More than once a day	At least once a day	More than once a week but less than once a day	At least once a week	Once every few weeks	Never
For work purposes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
For personal purposes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**5. For work purposes, how do you use the iPad-style tablet computer?**

**Figure 4.3:** Example screen from the online questionnaire component of the exploratory study

3. If you make a note using the tablet computer, do you take steps to print it, duplicate it, email it, or otherwise transfer it to another platform or location?
4. Do you email items to yourself from your primary office computer so that you can use them on the tablet? How often?
5. Do you email items to yourself from your tablet so that you can use them, for example, on your primary office computer? How often?
6. How often do you print items from any device? Which devices, and how often?

#### 4.3.4 Participation

The request for participation in the online questionnaire component of the exploratory was distributed widely online via social networks, as well as directly via business contacts of the researcher. Recruitment was targeted towards those employed in roles as knowledge workers.

Following the display of the participant information sheet and request for participation, the first question asked was whether participants used a tablet computer at all. It was not possible for them to proceed if they did not answer this question in the affirmative. Therefore, only users of tablets —that is, those who self-reported as tablet users —participated in the online questionnaire.

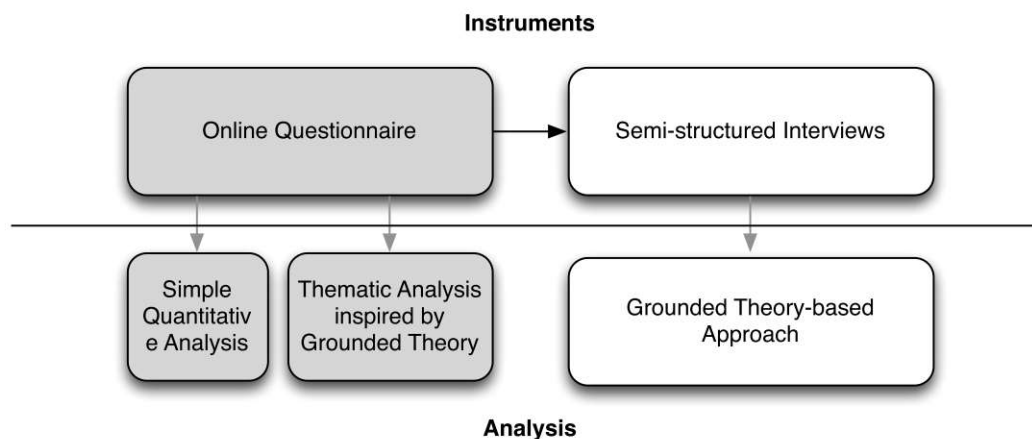
Following this question, participants were asked to nominate their profession in a free-form text field. As was discussed in [Section 3.4.1](#), this data was massaged in order to effectively tally each reported profession. It was intended to exclude data supplied by participants whose reported profession did not match the definition of knowledge worker established in [Chapter 2](#), however this did not prove necessary since all participants reported a profession meeting the definition of knowledge worker used for the research project.

No material incentive, financial or otherwise, was offered in return for participation in the study. Participants who had taken part in Phase 1 were not recruited.

#### 4.3.5 Analysis

As with the analysis of the Phase 1 questionnaire data, reported on in [Section 3.3.5](#), the analysis for the Phase 2 questionnaire data was performed in two parts:

1. a thematic analysis of the responses to free-form questions;
2. a simple quantitative collation of the data from the questions on length of time using a tablet, frequency of tablet usage, use (and frequency of use) of specific transfer techniques, and printing frequency.



**Figure 4.4:** *The analysis techniques used for the online questionnaire component of the exploratory study*

As with the pilot study, the thematic analysis was the most meaningful of the two forms of data analysis, whilst the simple quantitative data was collected to give context to the qualitative results. The data collection and analysis took place during 2012.

A detailed discussion of the overall findings of the exploratory study, together with those from the semi-structured interview component (discussed later in [Section 4.4](#)) is presented in [Section 4.5](#). The following two sub-sections report on each part of the online questionnaire data analysis, and any initial results as appropriate, in turn. [Figure 4.4](#) illustrates the two analysis techniques in context, and the following two sub-sections report on each part of the analysis in turn.

#### 4.3.5.1 Qualitative Analysis

This section outlines the qualitative analysis, a thematic approach, performed on the data from the online questionnaire component of the exploratory study. The thematic analysis approach used for the qualitative analysis reported on for Phase 1 was used again here. A review of this analysis technique is not repeated here, and interested readers are instead directed to review the technique as it was previously detailed in [Section 3.3.5](#).

The components of analysis used were, again: Data Familiarisation, Initial Coding, Initial Theming, Theme Refinement, Theme Finalisation, Final Analysis.

The results from the application of this approach are discussed, along with other findings from the exploratory study, in [Section 4.5](#). In the remainder of this section, the codes and themes developed from the online questionnaire data, using the thematic analysis approach previously discussed, are presented.



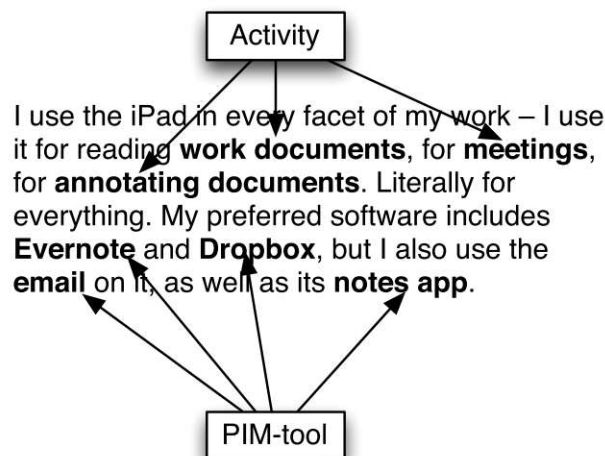
**Data Familiarisation** In the data familiarisation phase of the thematic analysis, the raw data of the online questionnaires was repeatedly reviewed by the researcher, until a comfortable and thorough sense and understanding of its components was established. At this phase, significant notes were made regarding the data, but no actual coding was conducted.

A repetitive and thorough review of the raw data ensured that the researcher had a detailed sense and feel for the data, as a whole, and was comfortable beginning a systematic analysis upon it.

**Initial Coding** In the first coding component of the thematic analysis, the interesting features of the data were identified. The simplest way to illustrate this is, again, by example. Consider the following participant quote, a free-form response to the online questionnaire:

*"I use the iPad in every facet of my work. I use it for reading work documents, for meetings, for annotating documents. Literally for everything. My preferred software includes Evernote and Dropbox, but I also use the email on it, as well as its notes app."*

Figure 4.5 shows the same participant quote with the initial codes being applied.



**Figure 4.5:** An extract of exploratory study online questionnaire data, with initial codes applied

As is anticipated with this thematic analysis technique (Braun and Clarke, 2006), a large variety of codes were developed in this initial coding component. Examples of some of the core codes extracted from the data in this component included:

- PIM-activities conducted with the tablet

- PIM-tools used on the tablet
- User experience issues in PIM-tools
- Work-arounds and strategies employed by individuals
- Frustration at working with data across multiple PIM-platforms

**Initial Theming** This component involved sorting, and extending, the exhaustive collection of codes that were developed into themes. Again, at this component, a variety of coded snippets from the data were collected, and matched to various themes, for future reference and use.

It is in this component that the initial thematic maps for the exploratory study online questionnaire were developed. The thematic map, as originally discussed in [Section 3.3.5.1](#), is a visualisation of the patterns and relationships in the data. An example of one of the thematic maps developed for this data set is shown in [Figure 4.6](#); this map clearly shows the initial themes of the data forming.

Examples of the central themes that were identified in this component of the thematic analysis include:

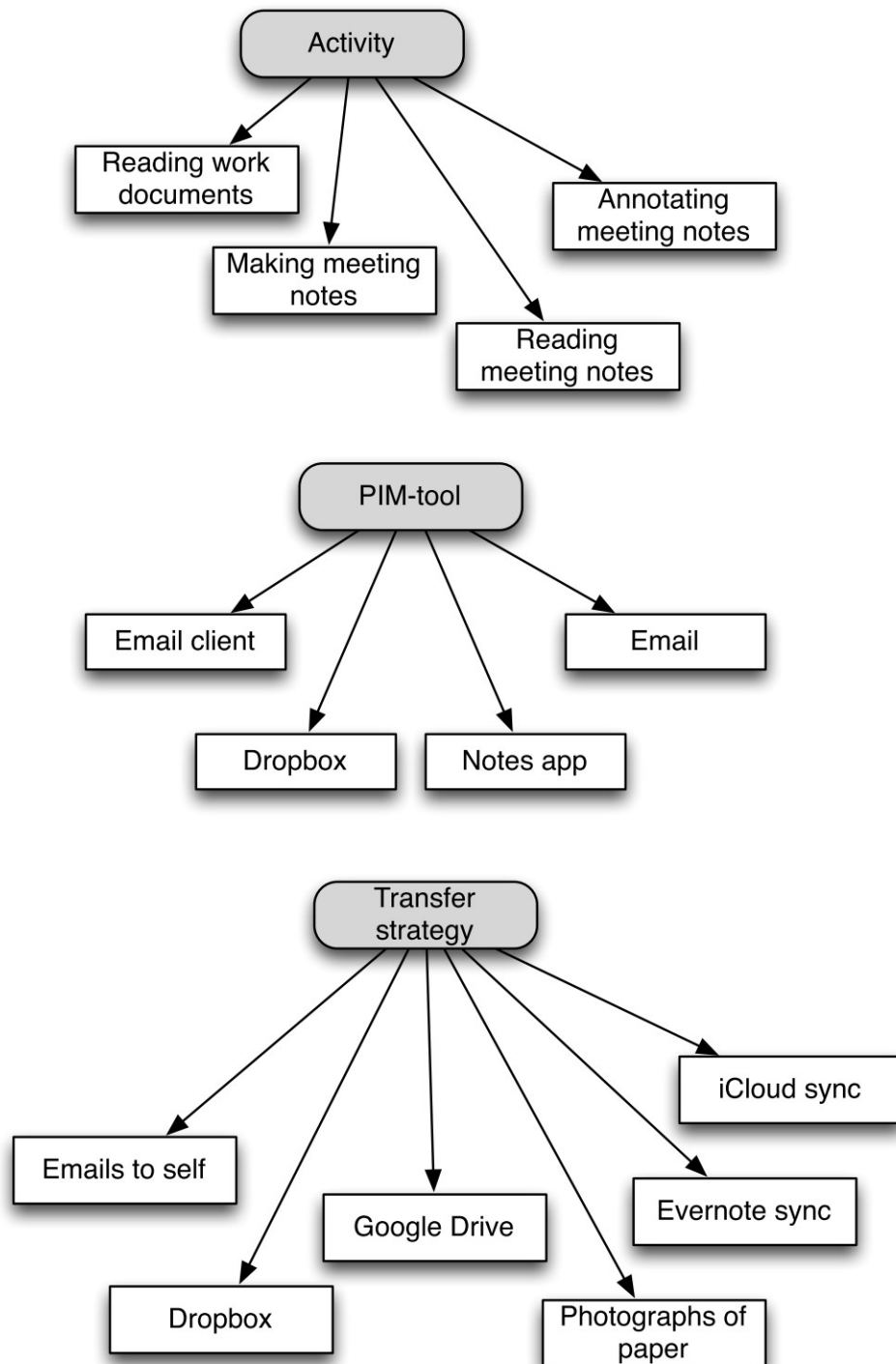
- Activities
- PIM-tools
- Transfer strategies
- Context maintenance strategies

**Theme Refinement** The process of refining the themes, and developing finalised thematic maps of the exploratory study online questionnaire data involved a systematic review of the themes code and codes.

An example of one of the finalised thematic maps developed is shown in [Figure 4.7](#). This component of the thematic analysis involved reflecting and considering whether the themes thus far were accurate reflections of the data as a whole ([Braun and Clarke, 2006](#)).

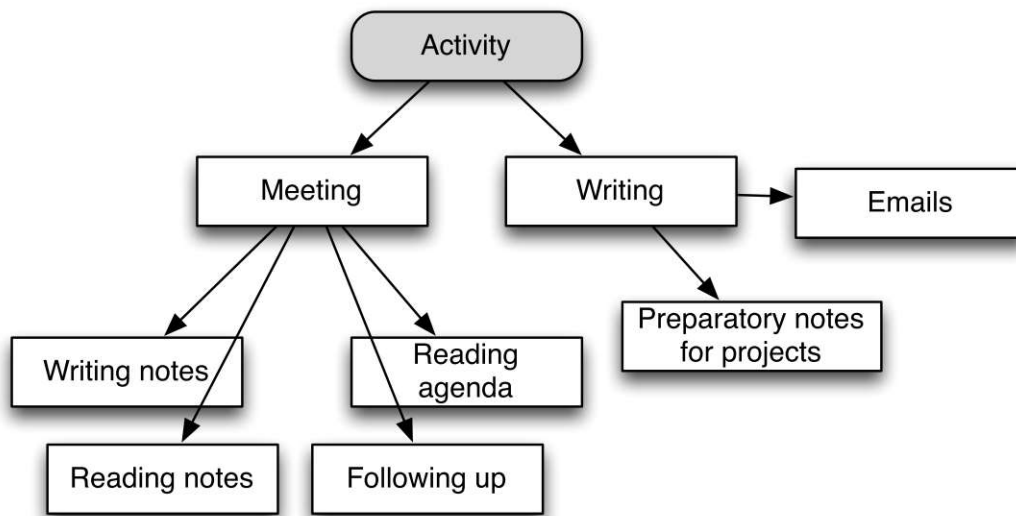
**Theme Finalisation** The finalisation of the themes involves refining, combining, purging, and evolving the themes that were developed. In this component, the spirit of each theme is identified and written up, and the coded snippets of data that were collected throughout the analysis sorted, reviewed, and collected into a narrative.

The themes were also reviewed for appropriateness, sub-themes, and any overlap with other themes.



**Figure 4.6:** An example of one of the initial thematic maps developed from the exploratory study online questionnaire





**Figure 4.7:** An example of a piece of one of the final thematic maps developed from the exploratory study online questionnaire data

**Final Analysis** In the final component of the thematic analysis, the narrative for presenting the results and the salient themes were reviewed. Data here was also related back to the objectives of the study in order to determine how the study addressed its objectives.

The results identified through thematic analysis are presented in [Section 4.5](#).

#### 4.3.5.2 Quantitative Analysis

A simple analysis of the data from questions in the online questionnaire related to frequency of use of the tablet for various aspects of PIM was conducted. The questions that were tallied related to:

- how long participants had used a tablet;
- how often participants used a tablet;
- how often, for a variety of specific reasons, participants used a tablet;
- how often participants print from the tablet, email themselves to or from the tablet.

It was felt that this represented a sufficient quantitative component for the data analysis of this component of Phase 2, as the design of the online questionnaire was largely around the collection of qualitative data. The minor pieces that reflected a quantitative approach were designed to provide additional context to the discussion

of the qualitative-based findings derived from the thematic analysis of the free-form answers.

## 4.4 Semi-structured Interviews

The second component of the exploratory study was a series of semi-structured interviews. Contrasting the broad perspective of the semi-structured interviews conducted for the pilot study, the goal of these interviews was to explore, and create a depth of understanding around, the use of the tablet by knowledge workers in a cross-platform PIM environment. The classifications, perspective, and initial understanding developed from both the entirety of the pilot study, and the online questionnaire component of Phase 2, were used to develop the semi-structured interviews.

The remainder of this section reports on the design and process of the semi-structured interviews conducted for the exploratory study. The full set of objectives for the exploratory study was discussed in detail in [Section 4.2.1](#). The experimental materials for the semi-structured interviews are available via <http://paris.id.au/>

The remainder of this section, exploring the decisions behind, scope, design, and analysis of the semi-structured interviews, is structured as follows:

- [Section 4.4.1](#) discusses the choice of methodology;
- [Section 4.4.2](#) explains the scope of the semi-structured interviews;
- [Section 4.4.3](#) discusses how the semi-structured interviews were designed and prepared;
- [Section 4.4.4](#) discusses recruitment and participation in the semi-structured interviews;
- [Section 4.4.5](#) notes how data from the semi-structured interviews was analysed.

### 4.4.1 Choice of Methodology

As with the pilot study, semi-structured interviews were selected as the second component of this study: their flexible nature, allowing for deep focus when required, was again sought after.

For further discussion on the use of semi-structured interviews in PIM research, see the commentary when semi-structured interviews were first introduced to the work in [Section 3.5](#) and [Section 3.5.1](#). [Section 2.3.1](#) also discussed the use of semi-structured interviews for data collection.

#### 4.4.2 Scope

The semi-structured interviews were designed to build a detailed picture of the challenges knowledge workers face in using the tablet for cross-platform PIM. The scope, therefore, of the semi-structured interviews was constrained in the following ways:

1. focus upon the use of the tablet in an office environment;
2. a mutable, but focused, approach on the other PIM-platforms of printed paper documents, and the primary officer computer, instead of encompassing all PIM-platforms. These two PIM-platforms were identified and discussed in [Section 3.4](#) of the discussion of Phase 1.
3. a mutable, but focused, approach on PIM-tools, with an effort to maintain the focus on the PIM-tools identified and discussed in [Section 3.4](#) as part of Phase 1.

The scope constraints of the overall project were previously discussed in [Section 1.2.1](#).

#### 4.4.3 Design

The interviews focused on the tablet and its role in the participants' PIM. As with the semi-structured interview component of the pilot study, the structure was carefully considered with an eye to encouraging free-ranging discussion by participants. Structured questions were broken into a number of different categories: background, focus, and general topics.

Background questions sought to establish a general overview perspective, providing context on the participant. Focus questions directed the semi-structured interview towards areas of interest derived from the results of the online questionnaire component of the exploratory study, and from the earlier pilot study. General topics were derived from the literature explored in [Chapter 2](#), the results of both the online questionnaire component of the exploratory study and the earlier pilot study, and from other areas of interest otherwise identified by the researcher.

Examples of the background questions used for the semi-structured interviews include:

1. What is your job title/profession?
2. What are your responsibilities?
3. What is your age?
4. How often do you use a tablet?



Examples of the focus questions used for the semi-structured interviews include:

1. Do you use a tablet computer for work?
2. Can you discuss how you use the tablet for work?

Example topics that were used in general discussions during the semi-structured interviews include:

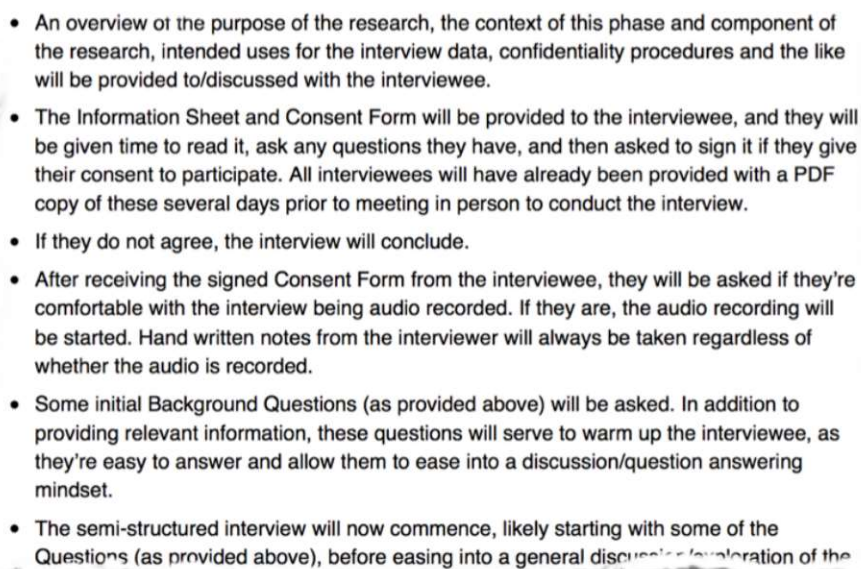
- transfer of data between multiple platforms;
- disconnection between paper information and electronic information;
- inability to share information between platforms;
- general challenges in managing personal information;
- specific challenges with specific tools used (e.g. Dropbox, Outlook, Evernote, tablets in general, Computer in general and so on).

The researcher attempted to maintain an informal focus on the most prevalent PIM-tools that were identified during the pilot study (as reported in [Section 3.4.2.2](#)), and frequently specific questions regarding these tools were asked by the researcher after it was established that participants utilised them. A guided tour of their office and information environment was again asked of participants, this time with a strong focus on their use of the tablet. Likewise, the overall structure of the interview was driven by [Barreau's \(1995\)](#) conceptual model. The model was originally discussed in [Chapter 2](#), defining the following sub-activities of PIM:

- acquisition of items;
- organisation of those items;
- maintenance of the collection;
- retrieval of items from the collection.

Participants were encouraged to discuss problems that they encountered with PIM, as well as the specific PIM-tools and PIM-platforms that they chose to use. The semi-structured interviews that were reported on in [Chapter 3](#) as a component of the pilot study made it clear that it would be necessary to press participants to be explicit about the variety of ways, and processes they used, to manage their information on tablets. Participants in the pilot study frequently made, or began their commentary,

with very broad generalisations or observations about the process of PIM and cross-platform PIM; it was therefore decided, for the exploratory study semi-structured interviews, to more directly encourage participants to make specific statements, explanations, and give examples of what they were talking about. The researcher believes that this line of questioning was highly beneficial to the research process, and resulted in information relevant to the goals that would not have been made available through, for example, online questionnaires or a more relaxed form of questioning (Mullins and Kiley, 2002; Lazar et al., 2010).

- 
- An overview of the purpose of the research, the context of this phase and component of the research, intended uses for the interview data, confidentiality procedures and the like will be provided to/discussed with the interviewee.
  - The Information Sheet and Consent Form will be provided to the interviewee, and they will be given time to read it, ask any questions they have, and then asked to sign it if they give their consent to participate. All interviewees will have already been provided with a PDF copy of these several days prior to meeting in person to conduct the interview.
  - If they do not agree, the interview will conclude.
  - After receiving the signed Consent Form from the interviewee, they will be asked if they're comfortable with the interview being audio recorded. If they are, the audio recording will be started. Hand written notes from the interviewer will always be taken regardless of whether the audio is recorded.
  - Some initial Background Questions (as provided above) will be asked. In addition to providing relevant information, these questions will serve to warm up the interviewee, as they're easy to answer and allow them to ease into a discussion/question answering mindset.
  - The semi-structured interview will now commence, likely starting with some of the Questions (as provided above), before easing into a general discussion/exploration of the

**Figure 4.8:** A segment of the reference sheet used for conducting the exploratory study semi-structured interviews

A segment of the reference sheet utilised by the researcher while conducting the exploratory study semi-structured interviews is shown in Figure 4.8. Each semi-structured interview lasted between 1 and 2 hours, and was carried out in the usual office of the interviewee, where it was possible to discuss their use of the tablet for PIM in context. The researcher spent the cumulative total of eight weeks of fulltime work conducting the semi-structured interviews for the exploratory study.

As noted in Section 4.2.3, a number of privacy-related precautions were employed. This, again, was due to the highly personal nature of PIM. As was noted in Chapter 1, a primary consideration of this study was a desire to not make participants feel uncomfortable.

Before each interview, the researcher stated that the participant's personal approach to managing information was not being evaluated in any way. All participants

also signed a release form acknowledging that the data would be anonymised before analysis and publication. A copy of the form is available via <http://paris.id.au/>. Following this, basic demographic information was collected, this is presented in [Table 4.1](#).



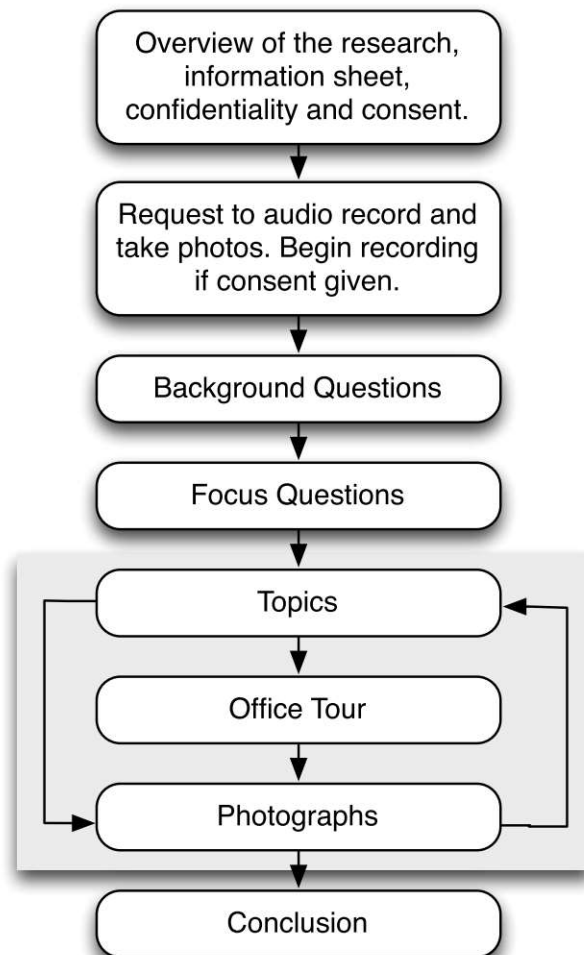
	Gender	Age	Occupation
P1	Female	20	Legal Archivist
P2	Male	25	Legal Archivist
P3	Male	38	Criminal Lawyer
P4	Female	42	Criminal Lawyer
P5	Female	60	Criminal Lawyer
P6	Male	29	Software Engineer
P7	Male	36	Telecommunications Analyst
P8	Male	51	Professor
P9	Male	45	Professor
P10	Male	39	Professor
P11	Male	38	Doctor (GP)
P12	Male	27	Doctor (GP)
P13	Male	27	Software Engineer
P14	Male	28	Software Engineer
P15	Male	49	Electrical Engineer
P16	Male	23	Software Engineer
P17	Male	27	Electrical Engineer
P18	Female	36	Electrical Engineer
P19	Male	59	Veterinarian
P20	Male	61	Teacher

	Gender	Age	Occupation
P21	Male	29	Telecommunications Analyst
P22	Male	29	Telecommunications Analyst
P23	Male	42	Telecommunications Analyst
P24	Male	30	Architect
P25	Male	28	Architect
P26	Female	49	Architect
P27	Male	50	CEO
P28	Male	28	Police Officer
P29	Female	38	Professor
P30	Female	40	CEO
P31	Female	27	Police Officer
P32	Female	26	Airline Analyst
P33	Female	29	Telecommunications Analyst
P34	Male	27	Telecommunications Analyst
P35	Female	27	Software Engineer
P36	Female	38	CEO
P37	Male	27	Software Engineer
P38	Male	38	Police Officer
P39	Female	42	CEO
P40	Female	61	CEO

	Gender	Age	Occupation
P41	Male	40	Police Officer
P42	Male	42	CEO
P43	Male	60	Professor
P44	Male	49	Professor
P45	Male	25	Software Engineer
P46	Female	26	Software Engineer
P47	Male	30	Airline Analyst
P48	Male	40	CEO
P49	Female	25	Airline Analyst
P50	Female	29	Journalist
P51	Female	34	Journalist
P52	Female	39	CEO
P53	Female	45	CEO
P54	Male	44	Professor
P55	Female	35	Software Engineer
P56	Female	50	Senior Librarian
P57	Male	42	Pharmacist
P58	Male	48	CEO
P59	Female	24	Charity Worker
P60	Female	27	Charity Worker

**Table 4.1:** Basic demographic information collected from the exploratory study semi-structured interview participants

A diagram of the process used for these semi-structured interviews is shown in [Figure 4.9](#).



**Figure 4.9:** *Diagram of the semi-structured interview process used in the exploratory study*

The basic process of the semi-structured interviews that was used was built from that described in [Brenner \(1985\)](#), [Frey and Fontana \(1994\)](#), and [Fontana and Frey \(2005\)](#). Questions were asked from a series of categories, in order, with the order within those categories changing as needed to suit the manner in which the interview was progressing. The categories were loosely based on the sub-activities of PIM defined in [Barreau \(1995\)](#) as part of the conceptual model of PIM originally discussed in [Chapter 2](#).

#### 4.4.4 Participation

Participants were recruited via social networks, direct approach to a number of businesses, and through business associates of the researcher. Participants were required

to be knowledge workers, as defined in [Chapter 2](#), and not personally known to the researcher. Individuals who were users of tablets were deliberately sought but recruitment did not focus solely on tablet users. No material incentive, financial or otherwise, was offered in return for participation in the study. Participants who had taken part in the pilot study, or the online questionnaire component of the exploratory study, were not recruited so as to further broaden the participant base ([Lazar et al., 2010](#)).

In order to ensure participants to feel comfortable during the interview, participants were informed in advance that they were able to remove any items they did not want the interviewer to encounter (e.g. confidential information, medical reports, etc.) Interviewer exposure to content of specific items of personal information was avoided whenever possible. Prior to each interview the interviewer stated the participant's personal approach to managing information was not being evaluated in any way, and all participants signed a release form acknowledging that the data would be anonymised before analysis and publication.

#### 4.4.5 Analysis

The thematic analysis approach used previously in [Section 4.3.5.1](#) and throughout [Chapter 3](#) was not sufficient for building an understanding from the newest dataset. Whilst the technique was well suited to both the pilot study components and the online questionnaire component of the exploratory study, it was unsuitable for the deeper theory building and sense making that was required for the semi-structured interviews in this exploratory study ([Lazar et al., 2010](#)).

Therefore, for the semi-structured interview data from the exploratory study, a new approach based on grounded theory was developed and used to analyse the data. This particular inductive approach to data analysis allows for the distinct focus on the particulars of the tablet to be incorporated in the analysis, whilst also allowing for interpretive data collection and analysis.

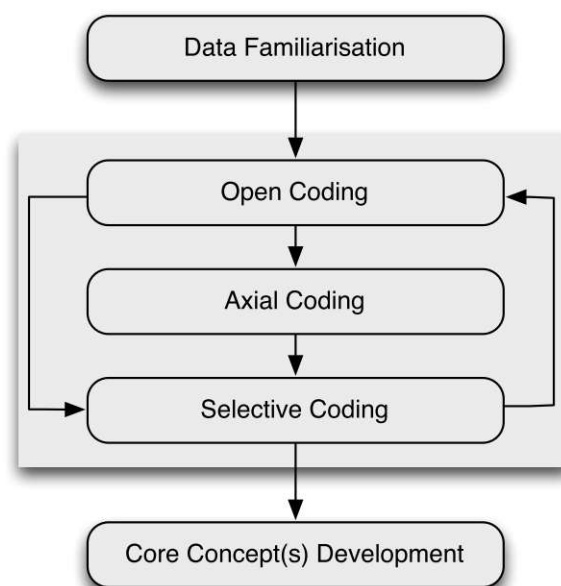
The use of a more traditional grounded theory-based methodology allows for the generation of strong explanatory discussion ("theory") from the data, capturing multiple perspectives, the unseen, and relating the unrelated ([Boyatzis, 1998](#); [Braun and Clarke, 2006](#)). The inductive, grounded nature of the analysis deeply linked the codes and themes to the raw data ([Lazar et al., 2010](#)).

Grounded Theory, and the methods surrounding it ("*Grounded Theory Methods*", or GTM), are designed to allow for an analysis that is deeply grounded in the data under investigation. It is important to note, first and foremost, that GTM are by no means step-by-step procedures that are applied to the data, or to participants of a study: GTM are methods that suggest how researchers might think about, or approach data



(Strauss, 1967; Muller and Kogan, 2010), they are methods that help researchers make sense of data (Charmaz, 2006). It is important to note here that GTM are neither designed for, nor suitable for, exploring a particular hypothesis, or attempting to prove particular statements (Suddaby, 2006). In this sense, GTM are very much inductive, rather than deductive, methods.

The GTM approach used for the semi-structured interview component of the study reported on in this chapter followed a fairly standard HCI research programme (Muller and Kogan, 2010). That is, the domain and type of data that was to be collected was known, therefore following the transcription of the data, the codes, themes, and categories were identified iteratively, then the categories were set in relation to each other, and a detailed analysis of the conceptual structure of the data was produced. While this approach does not mesh with the original ideology of early grounded theory approaches, as espoused by those such as Strauss (1967), it is a strong fit with the aims of this project as it allows for a deep, explanatory understanding of the raw data to be developed whilst still maintaining a deeper initial focus — although still not a hypothesis to test — on specific elements, such as the tablet.



**Figure 4.10:** *Phases of the grounded theory-based methodology used*

The GTM used here follows an approach that is somewhat a gestalt of those proposed by Charmaz (2006), Dick (2005), Star (2007), and Corbin and Strauss (2008). As noted by Glaser (1992), the output should be a product of the analyses, rather than merely illustrating earlier theories or ideas. The components of the GTM approach used were designed to extract key themes related to cross-platform tablet-based PIM.

The components are also based on those defined by [Corbin and Strauss \(1990\)](#), they are:

1. *data familiarisation* — the notation of initial ideas during a review phase to ensure that the researcher had a strong familiarity with the data;
2. *open coding* — open coding involves identifying repeated words and phrases found in the data;
3. *axial coding* — axial coding involves grouping the open codes into categories;
4. *selective coding* — selective coding involves focusing on the most important codes, reviewing those that occur most frequently, or in contrasting patterns ([Muller and Kogan, 2010](#)).

Essentially, every meaningful part of the data was coded (open coding), the relationships between these codes were identified and grouped into categories (axial coding), and the most important codes were identified, expanded, and explained (selective coding). Following the coding, the core concepts of the data are developed — this involves taking the choices made and codes finalised during the selective coding step and constructing a discussion around the more important — core — concepts of the data that were identified.

The following sections present an overview of the specific codes developed for each step of the analysis of the semi-structured interviews. [Section 4.4.5.1](#) to [Section 4.4.5.3](#) discuss each of these steps in detail.

#### 4.4.5.1 Data Familiarisation

The raw data from the semi-structured interviews were reviewed until the researcher was extremely comfortable and intimately familiar with it. Significant notes were made on the potential for future coding, but no actual coding or analysis was conducted in this phase. At the point when the researcher believed he was comfortable with the data, the following component was initiated.

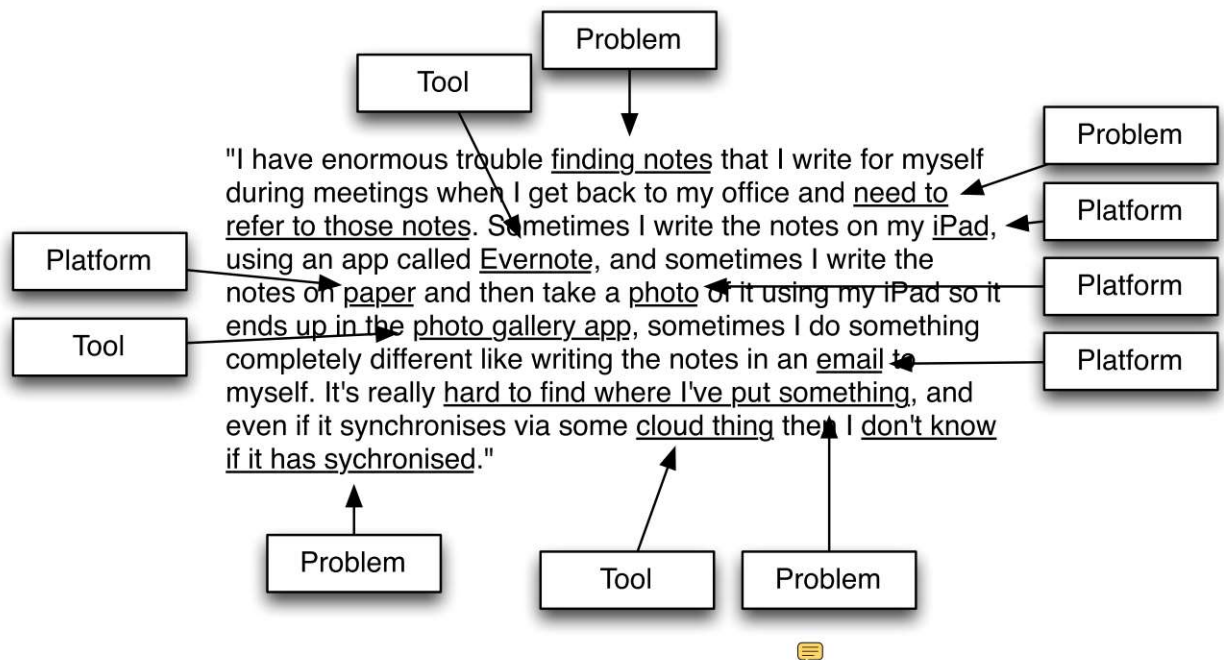
#### 4.4.5.2 Open Codes

In the open coding component, the transcripts for the answers to each free-form question were reviewed and marked-up. If a code appeared ambiguous at this point, the data was reviewed and the code updated for clarity. [Strauss and Corbin \(2007\)](#) suggest that open coding allows for the researcher's assumptions to be questioned as they analyse the data. Consider the following participant quote:



*"I have enormous trouble finding notes that I write for myself during meetings when I get back to my office and need to refer to them. Sometimes I write the notes on my iPad, using an app called Evernote, and sometimes I write the notes on paper and then take a photo of it using my iPad so it ends up in the photo gallery, sometimes I do something completely different like writing the notes in an email to myself. It's really hard to find where I've put something, and even if it synchronises via some cloud thing then I don't know if it has transferred."*

Figure 4.11 shows the same participant quote marked up with the initial open codes that were developed from it.



**Figure 4.11:** Example of open coding process

The process of open coding involved reviewing the data and building codes upon it in the following manner. It is important to note that the "open" of open coding refers to the fact that there are no pre-established codes, but rather codes that are developed as the analysis proceeds. The codes developed in the open coding component allowed for significant scrutiny of the data by the researcher; assumptions, such as those brought into the exploratory study by the results of the pilot study (the PIM-tool user experience problems, or the specific behaviours around frequency of tablet-usage, for example), are deeply questioned (typically for their presence in the data) in this component (Corbin and Strauss, 1990).

At some points, where it was felt that the potential open codes that could be developed would be ambiguous, the raw data was revisited and coded again. This often oc-

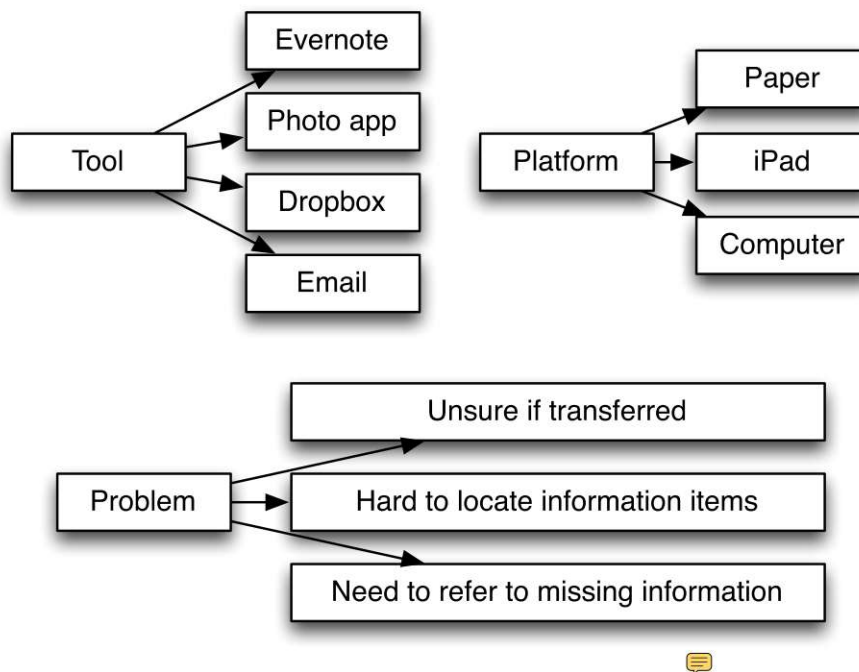


cured at a later date, a technique that ensured that the codes were strongly grounded in the data itself (Corbin and Strauss, 1990). The open coding process also involved, as its final pass, the deduplication of codes.

Spreadsheets were used to capture codes for all passes of open coding. The use of spreadsheets is a well established technique for capturing open coding, and was preferred by the researcher (Muller and Kogan, 2010). The specific product used was Apple's Numbers software (Apple, Inc., 2013b).

#### 4.4.5.3 Axial Codes

In the axial coding component, the codes developed in the previous component were sorted into groups of a similar conceptual theme (Glaser, 1992). As shown in Figure 4.12, the relationships amongst the codes begin to become defined in this component, and these relationships form clusters which are given names ("categories") (Charmaz, 2006; Corbin and Strauss, 2008; Muller and Kogan, 2010).



**Figure 4.12:** Example of axial coding process

It is this organisation of the codes into sometimes abstract conceptual categories that actually constitutes the "axial coding" of this component. Significant use of diagrams, as shown in Figure 4.12, helped facilitate representation and understanding of codes during analysis. The abstraction from the data is at a much higher level than in open coding during axial coding (Ryan and Bernard, 2009). Axial coding is central to Strauss and Corbin's (2007) work and Corbin and Strauss's (2008) work, but is

considered optional by Charmaz (2006).

#### 4.4.5.4 Selective Codes

In the selective coding component, the codes and categories that have been developed are filtered by importance, such that certain codes can be focused on, and the less important codes can be discarded (Muller and Kogan, 2010). The decisions, made by the researcher, of which codes are pursued for the analysis at this component is a vital component of GTM. Many scholars of grounded theory, and its associated methodologies, write at length of the importance that must be placed on the choices made by the researcher when utilising a GTM (Glaser, 1978, 1992; Corbin and Strauss, 2008; Charmaz, 2006; Muller and Kogan, 2010). This is why many scholars emphasise the "constructing" of a grounded theory (Charmaz, 2006).

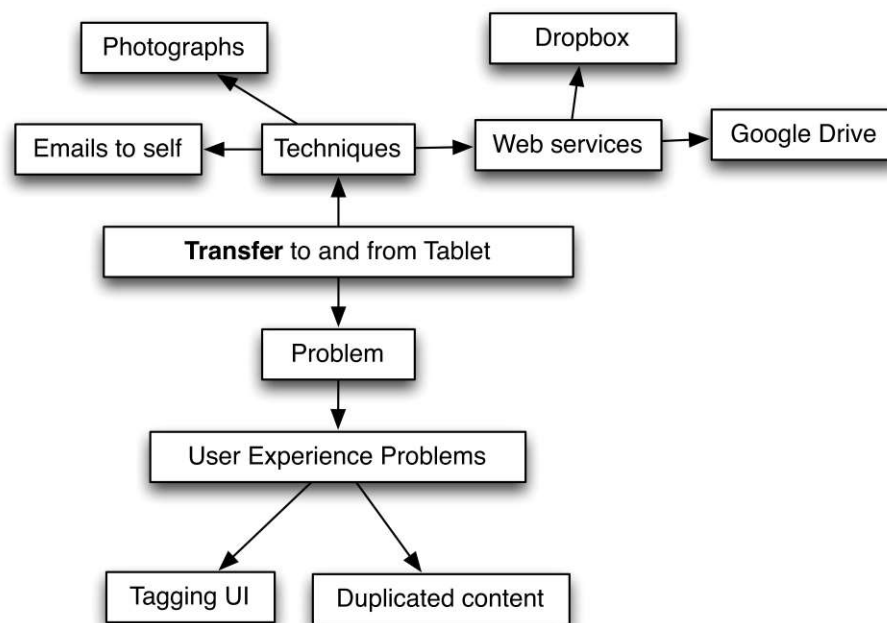


Figure 4.13: Example of selective coding process

The selective coding process, of which a component is presented as an example in Figure 4.13, involved describing the relationship of the axial codes, to their constituent categories and open codes. As with earlier components of the analysis, the use of diagrams helped significantly. The nature, attributes, and contribution of each individual axial code is reviewed. Themes selected during this final component must be representative and illustrative of the underlying data, but also must present a clear narrative (Muller and Kogan, 2010).

#### 4.4.5.5 Core Concepts

The GTM-based coding and analysis process gave rise to a number of core concepts for discussion; the core concepts revolved around the techniques and challenges of *transferring* information, *contextualising* information, and the use of *paper for micronotes, alongside tablets*. These core concepts are the primary outputs of the exploratory study, and together form the backbone of the following section

## 4.5 Findings

This section details the findings of both components of the exploratory study. As was the researcher's experience with the pilot study, participants were highly motivated to discuss their experiences with PIM. The data from the online questionnaire and semi-structured interviews conducted for the exploratory study allowed for a much deeper focus upon the most prevalent and challenging facets of PIM with tablets. The core findings from the exploratory study, as presented in this chapter, are again — as were the results of the pilot study, presented in [Section 3.6](#) — framed around the most prevalent facets of PIM suggested by the data:

- further exploration of the techniques and challenges of *transferring information* from other PIM-platforms to the tablet;
- further exploration of the techniques and challenges of *maintaining context* between other PIM-platforms and the tablet;
- further exploration of the use of the tablet for *micronotes*, and its unique relationship to *paper*.

The facets of *maintaining organisation*, whilst prevalent in the data from the pilot study, were not focused on during the exploratory study. The reason for this is that the most prevalent problems of maintaining organisation — tagging fatigue and the inability for software PIM-tools to identify duplicate content — were largely concerned with the inner workings of PIM-tools and were not highly confluent with the focus on cross-platform PIM that was emerging. Organisation is also an established component of [Barreau's \(1995\)](#) model, and has been well covered in past research — as discussed in [Chapter 2](#).

These findings were identified through the iterative review of the codes and themes developed during the thematic analysis that was performed on the online questionnaire data, and the approach based on grounded theory that was used performed on the semi-structured interview data. The latter followed the principles of grounded



theory to the letter (Corbin and Strauss, 1990); the core concepts that emerged as a result of the GTM-based analysis of the semi-structured interview data were nearly identical to the themes that were found through the thematic analysis technique used for both components of the pilot study. This validated both the premise of the research, and the approach to address the objectives (Lazar et al., 2010).

The following sections review the findings of the exploratory study:

- Section 4.5.1 reports on the participants of the exploratory study;
- Section 4.5.2 conducts a further exploration and discussion of the challenges of information transfer between PIM-platforms;
- Section 4.5.3 further explores the challenges of maintaining context between other PIM-platforms and the tablet;
- Section 4.5.4 scrutinises the use of the tablet for micronotes, probing the micronote capture and management techniques suggested by the data;
- Section 4.5.5 summarises and concludes the chapter.

4.5.1 Participants

As with the pilot study, both components of the exploratory study reached significantly beyond the local population. Participants were located in the United States, United Kingdom, Hong Kong, New Zealand, Canada, Russia, Greece, and Australia. The participant count for each component of the exploratory study is shown in Table 4.2.

Component	Count
Online Questionnaire	219
Semi-structured Interviews	64

Table 4.2: Participant count for each component of the exploratory study

This section discusses the participants in both the online questionnaire and semi-structured interview components of the exploratory study:

- Section 4.5.1.1 discusses the participants of the online questionnaire;
- Section 4.5.1.2 discusses the participants of the semi-structured interviews;
- Section 4.5.1.3 discusses the most prevalent PIM-platforms encountered.

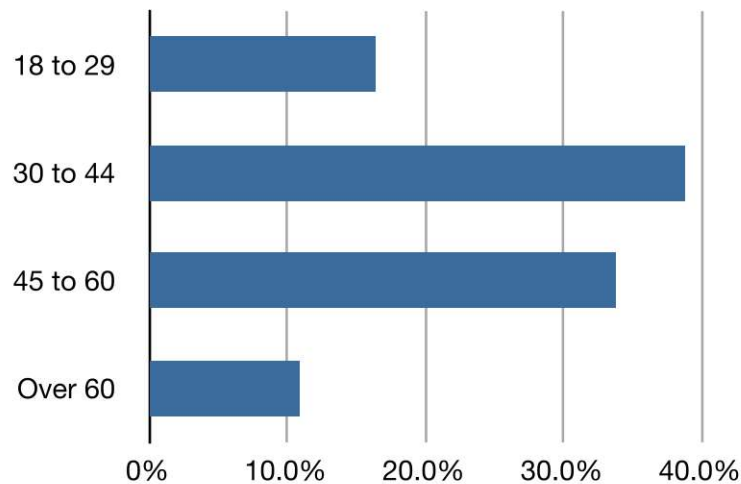
#### 4.5.1.1 Online Questionnaire

The questionnaire component was completed by 219 participants; 54% reported as male, and 46% reported as female. The participation rate for this component, when contrasted to past research, was excellent ([Lazar et al., 2010](#)). Unlike the pilot study, participants of the semi-structured interview component of the exploratory study were separately recruited. Participants of the online questionnaire were not asked if they would be interested in future participation.

Profession	Count
Criminal Lawyer	46
CEO	25
Legal Archivist	22
Doctor (General Practitioner)	20
High School Teacher	16
Telecommunications Analyst	16
Architect	13
Software Engineer	12
Financial Planner	12
Veterinarian	7
Charity Case Worker	7
Pharmacist	7
Author (Non-Fiction)	6
Senior Police Officer	4
Clinical Psychologist	3
Professor (Humanities)	3

**Table 4.3:** *Professions reported by participants of the online questionnaire component of the exploratory study*

Participants were asked to nominate their profession and age; a summary of the reported professions is presented in [Table 4.3](#), and a summary of the reported ages is reported in [Figure 4.14](#). The age of participants ranged from 24 to 65, and the mean age was 43. The distribution of participation ages represented a healthy spread of age groups. The high proportion of respondents from a legal background was coincidental. Fortuitously, all of the professions reported by participants fit within the definition of a knowledge worker used by this research, as discussed in [Chapter 2](#). A large percentage of the participants came from a criminal law profession — this was not intentional on the part of the researcher and participation rate of this profession is unlikely to have an impact on the data as all participants are knowledge workers practicing a similar set of PIM habits ([Reinhardt et al., 2011](#)).



**Figure 4.14:** *Ages reported by participants of the online questionnaire component of the exploratory study [n=219]*

#### 4.5.1.2 Semi-structured Interviews

There were 64 participants in the semi-structured interview component of the exploratory study. Participants were all knowledge workers, and were recruited using a variety of business connections as well as social networks. An overview of the professions of participants who took part is presented in [Table 4.4](#). Despite participation being open to users of all forms of tablet as defined in [Chapter 2](#), all participants were ultimately solely users of the Apple iPad. As with the pilot study this was not deliberate, but not surprising given the prevailing market conditions that were previously discussed in [Section 3.4.2.1](#) ([Cusumano, 2013](#); [Tellis, 2013](#)).

The distribution of participation ages again represented a solid spread of age groups ([Lazar et al., 2010](#)). The level of participation in the semi-structured interview component was strong when compared to similar past use of semi-structured interviews ([Lazar et al., 2010](#)).

#### 4.5.1.3 PIM-platforms

In line with the findings of the pilot study that were reported on in [Section 3.4](#), the most prevalent PIM-platforms encountered throughout the exploratory study were:

- tablet computer;
- office computer;
- paper documents.



Profession	Count
Airline Analyst	3
Architect	3
CEO	10
Charity Case Worker	2
Criminal Lawyer	3
Doctor (General Practitioner)	2
Electrical Engineer	3
Journalist	2
Legal Archivist	2
Pharmacist	1
Senior Police Officer	4
Professor (Humanities)	7
Senior Librarian	1
Software Engineer	9
Teacher	1
Telecommunications Analyst	6
Veterinarian	1

**Table 4.4:** Overview of participants of the semi-structured interviews in the exploratory study [ $n=64$ ]

### 4.5.2 Transferring Information

As was reported in [Section 3.6.3](#), during the pilot the study a large number of the most prevalent challenges of PIM for participants arose from attempts, or techniques used, to transfer information between PIM-platforms. [Barreau's \(1995\)](#) model was lacking in a number of areas in terms of its ability to describe the phenomena and activities related to cross-platform PIM that were observed and reported. As was done in [Chapter 3](#), this section discusses one of the additional facets of cross-platform PIM that was identified through the results of this exploratory study: *transferring information*.

This section focuses on the tablet and further explores the most prevalently reported approaches used for cross-platform transfer. The three most prevalent approaches to cross-platform transfer identified in the exploratory study were identical to those identified the pilot study:

1. participants emailing themselves digital documents from their office computer, for later retrieval and use on the tablet;
2. participants taking photos of printed paper documents using the inbuilt camera of a tablet ;
3. the use of popular web services, such as Dropbox and Google Drive, to transfer digital documents from the office computer to the tablet.

As with the pilot study, the prevalence of these approaches was identified by tallying the frequency of mentions for each participant, independently for both components of the study. The specific tallies for each of the three most prevalent transfer strategies are shown in Table 4.5. To maintain an appropriate and achievable scope, the researcher elected to focus on participants' experiences emailing themselves and using the tablet camera to take photos of paper documents (Approach 1 and Approach 2, above). These two strategies are now discussed in detail in Section 4.5.2.1 and Section 4.5.2.2 respectively. As noted in Chapter 2, the use of popular web services, such as Dropbox and Google Drive, has been widely explored in both industry and academia in a variety of contexts in the past (e.g. Hu et al. 2010; Marshall and Tang 2012; Masiyev et al. 2012).

	Questionnaire [n=219]	Interviews [n=64]
Emailing oneself	94%	93%
Photographing paper	80%	70%
Web services	38%	20%

**Table 4.5:** Percentages of participants who reported using each transfer approach

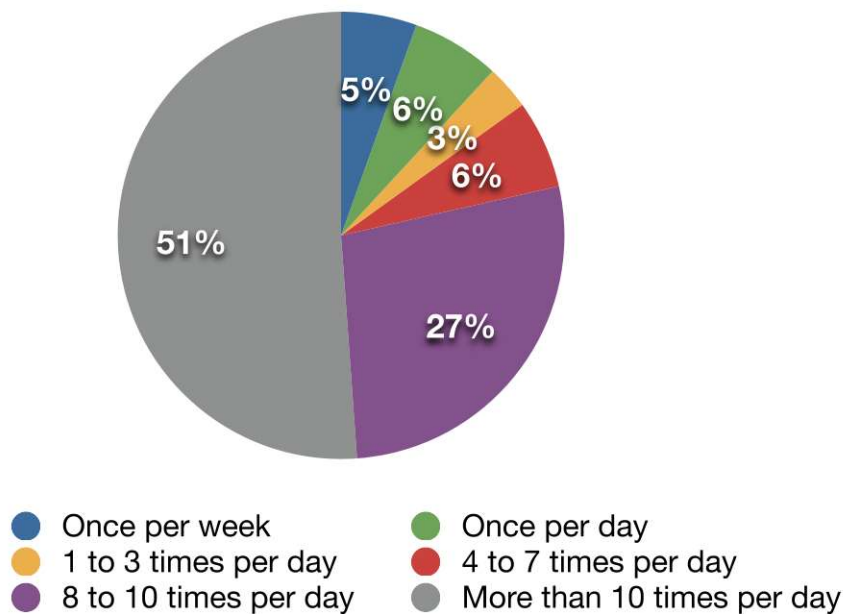
As was found in the pilot study, exploratory study participants also reported that transferring information became more complex the more PIM-platforms were involved in their daily PIM routines. For example:

*"The more things I need to manage my information on, the more complicated my daily [PIM] is. Like, meetings or days where I use my iPad, computer, and lots of paper or even my iPhone heavily are more complicated than days where it's just my iPad and paper."*

#### 4.5.2.1 Emailing Oneself

205 of the 219 participants of the online questionnaire reported that they, on a regular basis, emailed information to themselves from their office computer for use on their tablet. Many of these questionnaire participants reported emailing themselves upwards of 8 times per day. The high proportion of participants reporting this led to discussion of the reasons behind emailing oneself with participants in the semi-structured interview component. Figure 4.15 shows questionnaire participants self-reported frequency of emailing themselves.

56 of the 64 participants of the semi-structured interviews, who, unlike the pilot study, were not a subset of participants of the online questionnaire component of the exploratory study, reported that they frequently emailed themselves something, largely from the office computer with the intention of using it on the tablet. Whilst



**Figure 4.15:** Questionnaire participants' responses to question regarding emailing oneself [ $n=205$ ]

56 did it regularly, 52 of the 64 total semi-structured interview participants indicated that they felt that emailing themselves pieces of information, to their tablets was a crucial part of their PIM workflows. For example, one participant commented:

*"If I didn't or couldn't email myself notes and documents, for using on my iPad, the iPad would feel pretty useless to me! It's the linchpin of my use of it [the iPad]."*

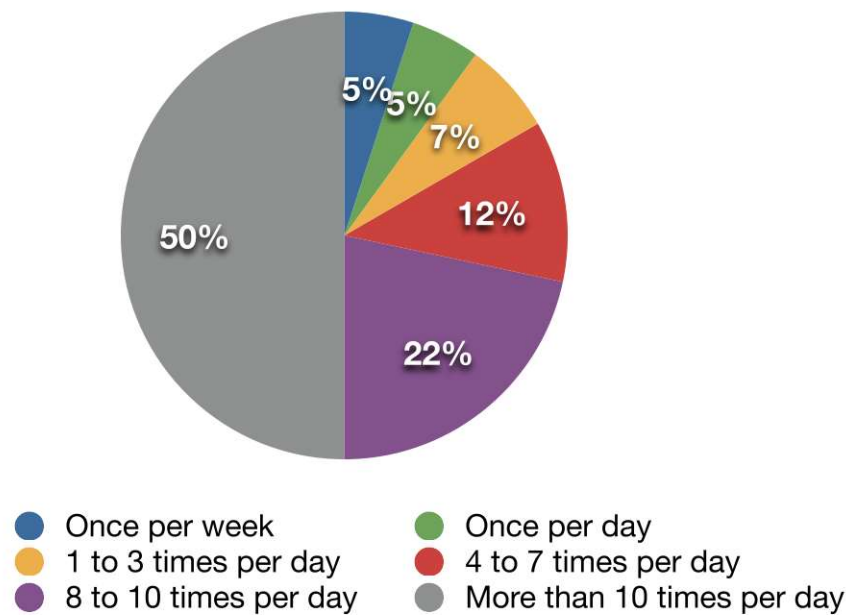
The frequency at which semi-structured interview participants reported emailing themselves is shown in [Figure 4.16](#); the results are very close to the frequencies reported by the participants of the online questionnaire component. This led to reinforce the conclusion that emails to oneself are an important PIM-strategy for transferring information employed, at the very least, by tablet users.

Of the 52 semi-structured interview participants who reported that emailing themselves was a crucial part of their PIM workflows, 48 expressed annoyance, displeasure, or general concern over the fragility or "hacky nature" (P16) of the technique. This sentiment is encapsulated in the words of one participant who observed:

*"Emailing myself so that I can get to useful documents while I'm using my iPad feels like taking a piece of the future [the iPad] and dragging it, kicking and screaming, into the past."*

All 56 participants who reported that they frequently emailed themselves information indicated that they felt that, when they did email themselves something, they had trouble working with or, retrieving, or otherwise making use of the content of





**Figure 4.16:** Semi-structured interview participants' responses to question regarding emailing self [n=56]

the information they had emailed. The following comments, from P36 and P54 respectively, illustrate the prevailing consensus amongst participants: whilst 52 of the 64 may consider it a core technique of their PIM, emailing themselves was *"made [PIM] hard to manage"*:

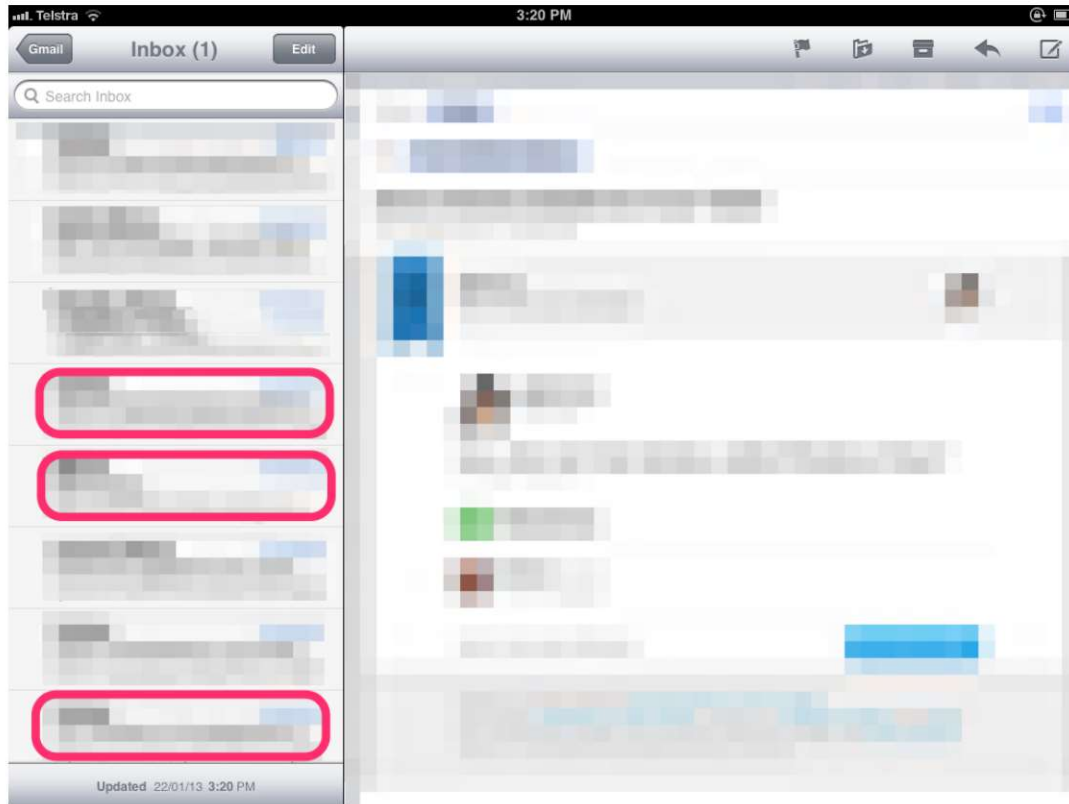
*"Of course! I do it all the time, I hate having to find information that I've transferred this way but it's most often the easiest way to do it. Sifting through the emails, which fill up by themselves anyway... it's terribly frustrating."*

*"Once I go to use the iPad and find my PDF [the information that has been emailed to themselves] I have to hunt through all the incoming email that piles up since I sent it [the email to themselves] so I can start reading!"*

As a transfer approach, the use of email to transfer files between PIM-platforms is quite pragmatic. It is, on the surface, a very simple way of transferring a file. As can be seen from the participant comments presented, and discussion so far, a variety of significant issues appear to emerge when this technique is widely employed, or employed for a long period. Emailing yourself a document is such a *"rushed, short term act"*, acknowledged by most participants to be untidy, unseemly, and *"embarrassingly difficult to actually follow-up and get work done from"*, that upon the reflection and in the light of the *"auditing effect"* (Boardman, 2004) studies of PIM have upon their participants, it can be seen for the inefficient, problematic *"kludge"* that it is.

Figure 4.17 shows an example of the large number of emails surrounding messages sent to, and from, oneself (in the case of one participant). This demonstrates the

challenge faced by individuals attempting to retrieve information transferred in this manner.



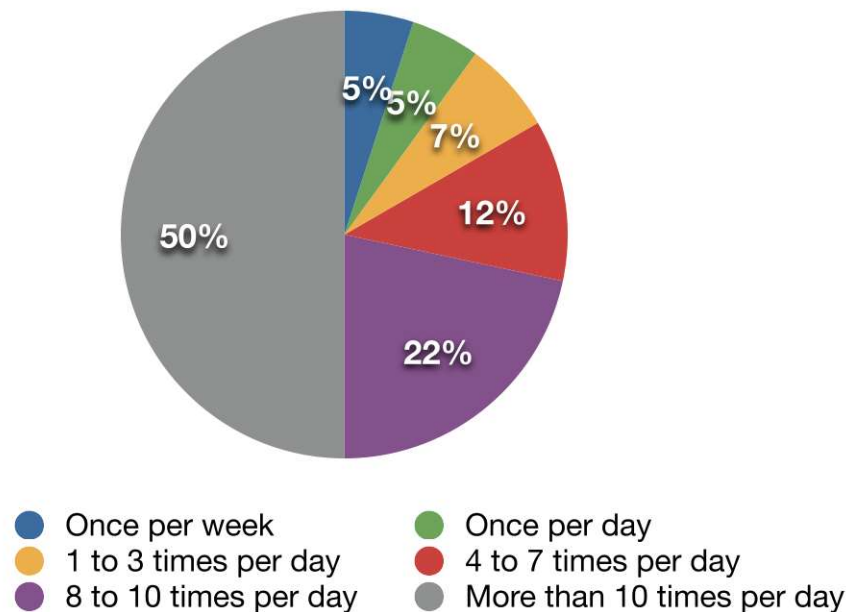
**Figure 4.17:** The "messy inbox" (P4) caused by participants' emailing themselves —emails to the owner of the iPad, from themselves, are highlighted amongst the long list of other emails

Whilst past studies of PIM, such as [Barreau and Nardi \(1995\)](#) and [Boardman \(2004\)](#), have identified and acknowledged the satisficing ([Brown, 2004](#)) nature of PIM in general, in this case the researcher suggests that the act of emailing yourself in order to transfer information between platforms is the ultimate example of the satisficing nature of PIM. The popularity and problematic nature of this techniques warranted addressing or, at the very least, further investigation and discussion.

#### 4.5.2.2 Photos of Paper

The second most prevalent approach to transferring information to the tablet involved the use of the inbuilt camera to take photos of paper documents. 176 of the 219 participants of the online questionnaire component reported that they frequently used the tablet's built-in camera to take a photo of a paper document to transfer it to their tablet. The majority of participants reported to doing this upwards of 4 times a day. As with the prevalence of emailing oneself, this led to a discussion of the reasons and techniques behind this with participants in the semi-structured interview component.

52 of the 64 participants of the semi-structured interviews also reported that they frequently used the tablet camera in this manner. The majority of interview participants also reported to doing this upwards of 4 times a day. The specific results of the interview that relate to the frequency of use of this technique are shown in [Figure 4.18](#).



**Figure 4.18:** Semi-structured interview participants' responses to question regarding using the tablet to photograph paper [n=42]

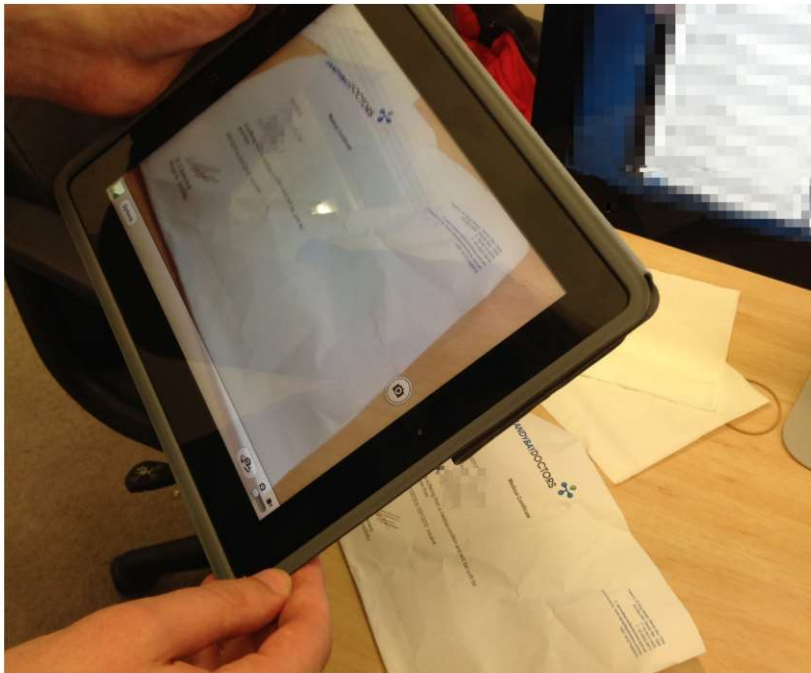
[Figure 4.19](#) illustrates the standard technique reported by most participants; this technique was demonstrated by participants during many of the semi-structured interviews. Whilst 52 of the 64 semi-structured interview participants reported to having done it at some point, 46 of them indicated that they felt the use of the camera for transferring the content of paper documents to their tablets was a crucial part of their PIM workflows. For example, one participant commented:

*"I think I'd be pretty lost if my iPad didn't have a camera, or I couldn't do this. Collecting stuff off paper using the iPad is pretty important, mostly so I can keep it together on the iPad, get rid of the paper, and I guess search for it."*

As suggested by the pilot study results, reported in [Section 3.6.3.2](#), a significant problem again identified by participants in the exploratory was the lack of support on the tablet, and in PIM-tools that run on the tablet, for using the built-in cameras as data input in this manner. One participant (P27) from the Phase 2 semi-structured interviews presented the observations that were typical of most of these participants:

*"I probably take photos of documents, whiteboards and stuff using it [iPad] more often than I type something into it. It just seems easier than typing or redrawing a*





**Figure 4.19:** An example of a standard PIM transfer approach employed by many Phase 2 participants: taking photos of paper documents with their tablet

*diagram, or even going to scan something in later on. None of the [iPad] software really has good support for this though."*

Other participants made more nuanced observations of this problem, such as this one (P60):

*"None of the software I use on the iPad really supports an understanding of what's going on when I take a photo of a document or of a scrap of paper. It's definitely within the realms of possibility that they could detect the edges of the paper, or just let me pick the edges of the paper in the image so the picture can be skewed properly on the iPad if I don't align it perfectly when I take the photo. It's just really frustrating that none of the software does much like this."*

Participants who reported using the tablet camera as input for their PIM during the semi-structured interviews were asked how often they utilised a scanner to transfer paper documents to digital form. The responses to this suggest that the use of a scanner, and the use of the tablet camera, are used for two distinct reasons in PIM. The following participant (P9) comment highlights this:

*"I don't scan very often, but when I do it's usually a really long document, something more than 3 pages or so, and I'm doing it because I want to keep it long term"*

*—it's usually unlikely that I'll want to refer to again soon if I'm scanning it. I photograph documents that are perhaps shorter, and that I think I'll need very soon. Maybe it's laziness?"*

Queried on the different ways in which they used the camera, as compared to a scanner, participants responded (P53):

*"The scanner? Perhaps when I feel like it needs to be archived, stored away, but not referred to soon or much."*

*"The iPad camera... when I need it right away and can't be bothered scanning it? I think that's about it."*

There was little variation in participant responses regarding this, with all essentially reporting that the scanner was to be used for "long" or "full" documents that would be "archived", "kept", or "useful later". Documents and paper captured using the tablet, however, was for "stuff I need right now", "transient scraps", "quick reference bits and pieces", and "quickly collecting".

Again, the revelation that the camera is such a focal point for tablet-based PIM, and the scanner was so infrequently used, and in such a different manner to the camera, came as unexpected findings. That participants generally observed that their favoured PIM-tools on the tablet had little support for one of their preferred means of acquiring information —acquisition being the first sub-activity of PIM as defined by Barreau (1995) —was surprising and warranted further investigation.

### 4.5.3 Maintaining Context

Again, Barreau's (1995) model was lacking in a number of areas in terms of its ability to describe the phenomena and activities related to cross-platform PIM that were observed and reported. This section discusses another facet of cross-platform PIM that was identified through the results of this pilot study: *maintaining context*.

Again, as with the pilot study that was reported on in Section 3.6.4, many of the most prevalent challenges discussed by participants also related to maintaining context across PIM-platforms. This section expands the discussion of the most prevalently reported problems related to maintaining context from other PIM-platforms on the tablet. The most prevalent problems identified during this exploratory study were identical to those identified in the pilot study:

1. lack of context, when using a tablet, regarding documents recently printed from an office computer;



2. lack of context, when using a tablet, regarding documents recently opened, or edited, on an office computer.

Instead of discussing each of these problems independently, this section considers them together, as they are essentially two manifestations of the same problem: maintaining context when moving between PIM-platforms to get something done. As with the data from the pilot study, the majority of participants felt that it was *"very challenging to think about information from the perspective of what sort of thing [platform] it's on. It's really hard to think about paper or the computer when I'm working on the iPad"*.

Of the 64 semi-structured interview participants in the exploratory study, 42 reported that they had trouble identifying or remembering the context of documents that they had printed from their desktop computer, particularly in a situation where they had, or intended to use, the paper documents and their tablet. 37 participants reported that they had trouble moving from their office computer to their tablet, usually for a meeting, with respect to the documents they had most recently used, and typically left open, on their office computer. The sentiments around both of these PIM-platform context problems were largely identical across participants from the pilot study and the exploratory study.

Jones (2012) observed that certain information can *"gain new life"* through its ability to be transferred or synchronised between multiple platforms. In this case the information either never gets the chance to move between platforms, because it gets forgotten or neglected due to the effort of figuring out precisely which piece of information it was, or causes more trouble than it is worth when retrieval is attempted on a different platform than it was on previously. In this manner we can see that these problems of maintaining context may be closely related to techniques and challenges of transferring information across PIM-platforms.

#### 4.5.4 Paper and PIM

This section reports on the use of the tablet for micronotes, and the effect that it appears to have on participants' use of paper. First discussed in [Section 3.4.3](#), as part of the initial findings of the pilot study, and again in [Section 3.6.6](#), as part of the overall findings of the pilot study, the use of the tablet for micronotes was a particularly striking facet of the data. The findings of the pilot study presented throughout [Chapter 3](#) suggested that the tablet may be supplanting the use of paper for the purpose of micronotes, and this suggestion was continued by the data from the exploratory study.

During the semi-structured interviews conducted for the exploratory study, micronotes were explicitly included as part of the discussion —that said, many partic-



ipants pre-empted the researcher in raising this and raised it themselves. 57 of the 64 semi-structured interview participants discussed micronotes and the tablet. All 57 suggested that their behaviour regarding micronotes had changed following the commencement of their tablet usage. Participants suggested that they formerly made such micronotes on paper, but had transferred this activity to the tablet:

*"I used to scribble notes to myself, usually to make me remember something to do later, all over bits and pieces in the office, but I do that all on the iPad now, mostly in my Evernote where I guess I can keep track of it better."*

This sentiment was echoed, regardless of which (if any) PIM-tool that participants identified as being used on the tablet to capture their micronotes:

*"I put my scrappy notes into the notes app on the iPad instead of scrawling things all over the paper on my desk now, it's much easier to actually act upon the crap I scrawl to myself now!"*

Upon expressing this sentiment, participants were asked why they considered it easier to act upon these micronotes, when they use the tablet to create and maintain them. Typical answers were:

*"Well, I don't really organise them as such, I think it's maybe that they're all in the same place, whereas before they weren't? Actually, I do search on the iPad, and that unearths things that I'd never have found if it wasn't on there."*

*"It's easier because it's there, it's in one place, and it's a place that it's easier to move things to and from other places from. If I write a phone number on a post-it note [sticky note] on my desktop, it's a lot more effort to put that into my address book. It's not when it's on the iPad."*

*"Search, it's definitely easier because I can search for things. I use Evernote, so I can search on all sorts of hints, contextual things I guess, like place or date and just search really."*

It therefore seems that the relationship of tablet usage to paper usage is perhaps significantly more nuanced and complex than it might appear on the surface, and whilst the paperless office may still be a pipedream, micronotes, at the very least, are a small showing in support of "paperlessness".

As with the results of the pilot study discussed in [Section 3.6.6](#), participants reported rarely using the "official tool" or "proper tool" when capturing micronotes:

*"I don't store stuff like this in the address book or the calendar, I just write it down on the iPad. If I need to put it into a proper tool I'll do it at some point after capturing it on the iPad."*

49 of the semi-structured interview participants identified micronotes together with their use of the tablet as presenting a number of challenges to their ability to practice PIM efficiently and in a stress-free manner. This supported the results of the pilot study, with most participants of the exploratory study also observing that they felt "out of control" as their tablet filled up with micronotes:

*"I feel totally out of control with the iPad when I use it for this sort of temporary information since it just fills up with it, and I sort of feel like I can find it OK [due to search] but there's just so much of it. When I didn't use the iPad for temporary info I just sort of swept it [paper and sticky notes off the desk] all into the bin and it was under control again. It's difficult to assess what's still relevant."*

As with the pilot study, a number of semi-structured interview participants made use of the tablet camera to capture micronotes: first annotating a paper document, often still a sticky note, before snapping a photo of the document and then disposing of the paper version. This behaviour was reported by 44 of the 64 semi-structured interview participants in the exploratory study. As with the pilot study, a number of participants demonstrated this in practice during the tour component of the semi-structured interviews. Discussing this practice, participants uniformly observed:

*"I do this because it's a lot easier to write quickly on the paper, but I don't want to keep the paper. My solution is to put it on the iPad and ditch the paper."*

Almost all of the participants who reported using the camera in this manner considered their technique to be unique:

*"I think this is a pretty unique approach to capturing temp info, I'm proud that I've come up with such an interesting way of keeping needed info around."*

#### **4.5.5 Understanding cross-platform PIM**

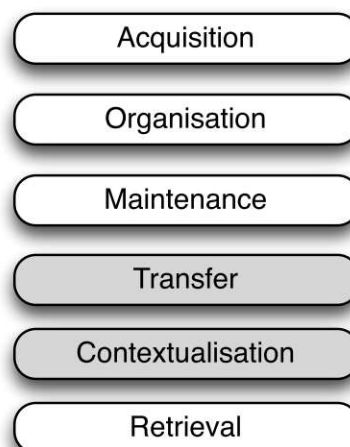
This section has reviewed the core findings of the online questionnaire and semi-structured interviews conducted as part of an exploratory study. The exploratory study, which was the first part of the second phase of the overall research project, was designed to develop an empirical basis allowing for an understanding of the challenges, technique, behaviour, and software user experience requirements around the

use of tablets for PIM, particularly PIM conducted by knowledge workers in an office environment.

The core findings of the exploratory study revolved around the concepts of *transferring information* between PIM-platforms and PIM-tools, *maintaining context* when working between different PIM-platforms and PIM-tools, and the *use of paper* as a PIM-platform alongside the tablet, especially for *micronotes*. Barreau's (1995) model of PIM was lacking in a number of areas in terms of its ability to describe the phenomena and activities related to cross-platform PIM that were observed and reported in both this study and in the pilot study. As a result of this, the following section presents a revision to Barreau's (1995) model including the components of "transfer" and "contextualisation" in order to account for cross-platform PIM.

Whilst the research uses the tablet as an exemplar, the core of the research is related to understanding cross-platform PIM. This section draws together the confluence of experiences and challenges reported by participants of the exploratory study and presents an initial conceptual model of cross-platform PIM derived from the findings so far and using the tablet as a case study.

The review of past work identified the use of conceptual models and frameworks to package and explore concepts, theories, and common user experiences surrounding PIM as a highly effective means of disseminating and discussing the results of PIM research, this was presented in Section 2.3.3.



**Figure 4.20:** The revised version of Barreau's (1995) model, to be used for exploring cross-platform PIM, highlighting the added components

The themes and subthemes present across the analysis of the pilot study and exploratory study data were combined to be presented as a conceptual model. This section summarises the components of the model and evidence for each thus far. The



conceptual model presented here is an evolution of the model proposed by Barreau (1995), and includes two additional components. Barreau's (1995) model consists of the following components:

- Acquisition
- Organisation
- Maintenance
- Retrieval

The evolution of this model, including components necessary for describing cross-platform PIM activities, consists of the following components:

- Acquisition
- Organisation
- Maintenance
- **Transfer**
- **Contextualisation**
- Retrieval

The added components, *transfer* and *contextualisation*, describe key components of the cross-platform PIM workflow identified in the pilot and exploratory studies. In Chapter 5, a number of the core components making up this conceptual model are used to develop a number of software PIM-tool prototypes designed to address a number of the challenges of cross-platform PIM involving the tablet that have been identified through the studies so far.

The prototypes are subsequently evaluated, along with the conceptual model, in the case study presented in Chapter 6. The conceptual model is then discussed using the holistic results of the entire research project in Chapter 7. Below, a brief overview of the core components added to the conceptual model in order for it to represent cross-platform PIM as it has been observed and reported so far is presented. The later development and evaluation of the prototypes continues the UCD-inspired approach of the work.

**Transferring Information** Transferring information relates to the techniques and problems concerned with transferring information to, or from, a PIM-platform. In the case of the tablet, the most common transfer techniques in the current studies were emailing documents to oneself for use on the tablet, take photos of paper documents using the tablet, and using web services such as Dropbox and Google Drive to transfer files to the tablet.

**Contextualising Information** Contextualising information relates to the contexts, techniques, and problems concerned with individuals moving between different PIM-platforms and attempting to continue working with a similar or related set of information as they were using on the previous platform. This move between platforms is in terms of a working day, rather than a platform switch.

## 4.6 Conclusions

This chapter has reported on the online questionnaire and semi-structured interviews that were conducted for the exploratory study phase of this research. In the exploratory study, 219 participants took part in an online questionnaire designed to further explore the context of the tablet in participants' PIM, and 64 participants, who had not participated in the online questionnaire, took part in semi-structured interviews to probe deeper. The findings of the exploratory study can be broken down into the following facets:

- further exploration of the techniques and challenges of *transferring information* from other PIM-platforms to the tablet;
- further exploration of the techniques and challenges of *maintaining context* between other PIM-platforms and the tablet;
- further exploration of the use of the tablet for *micronotes*, and its unique relationship to *paper*.

Broadly, the exploratory study has fulfilled the objectives it was designed to, as discussed in [Section 4.2.1](#), by:

1. furthering exploring, and confirming as relevant, the facets of transferring and contextualising as central to cross-platform PIM;
2. continuing to build the empirical groundwork for the construction of a number of software PIM-tool prototypes;

3. provided an initial recommendation on the structure of a conceptual model of cross-platform, evolving Barreau (1995) model to include facets necessary for describing cross-platform PIM.

Similarly, in line with the objectives of the overall research that were discussed in Section 1.2.1, the exploratory study has:

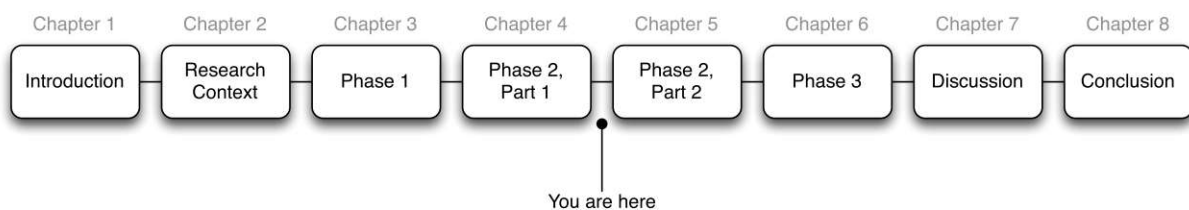
1. continued to develop an understanding of cross-platform PIM and PIM practices involving tablet technology;
2. provided the initial recommendations for an empirically-grounded model of cross-platform PIM;
3. laid the groundwork necessary for constructing a number of software PIM-tool prototypes for exploring common cross-platform PIM challenges, with a particular focus on tablet technology.

The findings around *"transferring information"*, *"maintaining context"*, and the use of paper for PIM provide a solid basis for future investigation and PIM-tool development, and address significant literature gaps that were identified.

It is argued that the study reported in this chapter was successful in meeting its objectives. A wide range of findings have been presented, and the core concepts arising from the exploratory study both confirm and showcase the validity of the research premise.



In the following chapter the conception and design of a number of software PIM-tool prototypes for the tablet is presented. The prototypes were designed to further explore the conceptual model under development, and support a number of the most prevalent challenges of cross-platform PIM involving the tablet that were identified through the pilot and exploratory studies.





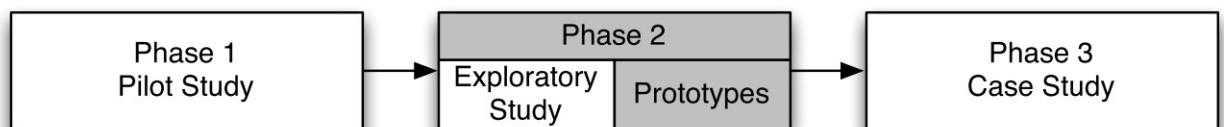
*I love taking an idea to a prototype  
and then to a product that millions  
of people use.*

—S. Wojcicki

# 5

## Phase 2: Part 2, Design

**T**HIS chapter presents a discussion of Part 2 of Phase 2 of the overall research project: the conception and development of a number of iPad-focused PIM-tool software prototypes designed to further explore the challenges of cross-platform PIM and allow for a deeper understanding of the requirements of tools that support cross-platform PIM.



**Figure 5.1:** *Phase 3 Part 1: Prototypes*

### 5.1 Introduction

From the beginning of the research, the researcher felt that it was crucial for the work to represent the principles and ideas of heavily pragmatic, practical studies — thus, despite an initial aversion to prototypes, it was decided that it was useful to proceed by building and then exploring and evaluating several prototypes. Therefore, this chapter reports on the design, implementation and initial evaluation of several PIM-tool software prototypes. The prototype PIM-tools were conceived to further explore the challenges of cross-platform PIM and the tablet, and validate the findings of the pilot study and exploratory study. The use of the prototypes by study participants is re-

ported on, as part of a final case study investigating cross-platform PIM, in [Chapter 6](#), and also forms part of the discussion in [Chapter 7](#).

As was noted in [Section 2.5.3](#), the original intention of the research was to be inspired by —but not strictly follow —a user-centred design (UCD) methodological pattern. The typical stages ([Harrison et al., 2010](#)) in a UCD project are:

1. *gathering of requirements* —a requirements gathering phase, empirically grounding the later parts;
2. *design and implementation* —design work and prototypes, motivated by the results of the requirements gathering;
3. *evaluation* —the evaluation or exploration of the design.

As has been stressed, this study is not a UCD-study, but draws great inspiration from the structure and objectives of such a study.

The prototype software PIM-tools were all designed to be extremely simple, offering only the most basic necessary functionality to serve their purpose. The basic functionality developed was in the hope that the learning curve would be straightforward, with the goal of participants swiftly mastering their use. Simple prototypes in order to allow swift mastery has been demonstrated to work well in past studies (e.g. [Van Kleek et al., 2009](#); [Bernstein et al., 2008](#)), as discussed in [Section 2.3.4](#).

It is important to note that, unlike many past studies (e.g. [Dumais et al., 2003](#); [Jones et al., 2005](#)), the core offering of this thesis was not the development of prototypes —the prototypes presented in this chapter were developed in order to further explore and validate the facets of cross-platform PIM being explored. They were not necessarily intended to be novel solutions to the problems of cross-platform PIM, but rather components used in the holistic exploration of the challenges of cross-platform PIM and tablets.

### 5.1.1 Chapter Structure

The discussion of the design and development of the prototypes is presented over the following sections:

- [Section 5.2](#) summarises the approach taken for the design and development of the prototypes;
- [Section 5.3](#) discusses the decisions behind what to build for the prototypes and the technological choices around implementation;
- [Section 5.4](#) discusses the first prototype;

- [Section 5.5](#) discusses the second prototype;
- [Section 5.6](#) discusses the third prototype;
- [Section 5.7](#) reports on a short initial evaluation designed to confirm the viability of the prototypes;
- [Section 5.8](#) summarises the work reported on the chapter.

## 5.2 Approach

Part 2 of Phase 2 involved the design and development of a number of software PIM-tool prototypes. The development of prototypes was, initially, driven by two central goals:

1. the desire to contribute to, and create, a pragmatic, practical piece of research;
2. and the desire to evaluate and explore the facets, challenges, and components of cross-platform PIM that were identified in the pilot and exploratory studies in a practical manner.

Whilst the design and implementation of these prototypes was primarily designed to explore some of the core problems and facets of cross-platform PIM identified through the pilot and exploratory study, the prototypes also serve to explore means for evaluating PIM-tools. PIM-tool evaluation is a noted sticking point in past research, as noted in [Section 2.3.4](#). The remainder of this section reviewing the approach taken to the prototype development is structured as follows:

- [Section 5.2.1](#) reports on the objectives of the design and prototyping;
- [Section 5.2.2](#) discusses the method and approach taken to the prototyping;
- [Section 5.2.3](#) summarises the contributions to the thesis made by the prototypes.

### 5.2.1 Objectives

The high-level objectives of the design component of this thesis were as follows:

1. *to explore one or more of the problems faced by individuals practicing cross-platform PIM involving a tablet* —ideally building a deeper knowledge of at least one of the problems that was identified through the results of the pilot and exploratory studies;



2. *to develop a software PIM-tool prototype that allow for the exploration and deeper understanding of issues around cross-platform PIM and tablet technology* —the PIM-tools were not necessarily aiming to be novel, but rather tools that allowed for the further exploration and understanding of the facets of cross-platform PIM that have been identified;
3. *to make initial recommendations regarding the evaluation of software PIM-tools* —evaluating software PIM-tools is a challenging task, and significant bodies of past research have failed to settle on any consistently reliable means of doing so.

### 5.2.2 Method

In line with a selection of past research in this area, but in contrast to most of it, the design approach for conceiving, building, iterating upon, and ultimately evaluating the concepts discussed in this chapter was inspired by user-centred design (UCD). [Vredenburg et al. \(2002\)](#) defines UCD as the practice of:

*"the active involvement of users for a clear understanding of user and task requirements, iterative design and evaluation, and a multi-disciplinary approach"*

This work matches to the principles defined by the ISO standard for user-centred design, in that it involves design based upon an explicit understanding of users and the tasks they are performing, involves the users in the design, and the design is refined based on user input ([ISO, 1999](#)). This work was not intended to be a strict UCD project, as the goals of illuminating the area in detail sat equally alongside the goals of developing news systems for support users.

The design process here was performed to explore incremental improvements on the current situation. It sought to improve the *status quo*, the way people currently practice PIM, rather than propose a radical alternative to current tools ([Boardman, 2004](#)). In this sense, it sits with practitioners of PIM research who propose incremental, or cumulative, *"hill climbing"* ([Carroll, 2000](#)) approaches to design (e.g. [Lansdale, 1988](#); [Whittaker et al., 2000](#), amongst others).

### 5.2.3 Contributions

This work reported on in this chapter primarily makes the two contributions to the thesis:

1. The design and development of three software PIM-tool prototypes for the iPad platform, allow for the exploration and addressing of a number of facets of cross-platform PIM.

2. The results from an initial, brief, evaluation of the functionality of the three prototypes, designed to confirm their viability for use by participants.

Components of the work discussed in this chapter were reported on in papers which are currently under review for publication.

## 5.3 Prototypes

This section reports on the options that were considered for prototyping, justifies the selection of the prototypes that were chosen, and summarises the technological platform selected for prototype implementation. This section is structured as follows:

- [Section 5.3.1](#) reports on the possible candidates for prototyping that arose based on the results of the pilot and exploratory studies;
- [Section 5.3.2](#) discusses the technical implementation of the prototypes;
- [Section 5.3.3](#) discusses the automatic data logging performed by the prototypes;
- [Section 5.3.4](#) summarises the core implementation challenges.

### 5.3.1 Potential Prototypes

This section discusses the possible avenues for prototyping that were explored, and explores how the prototypes that were chosen for implementation were decided upon. The challenges identified for potential prototypes, for which it was feasible to construct prototypes to explore, were:

1. *emails to self* — a cross-platform transfer technique that was observed to cause a multitude of challenges to PIM. Originally discussed in [Section 3.6.3](#) and [Section 4.5.2](#);
2. *camera as data input* — photographs of printed documents, another cross-platform transfer technique, was also observed to pose challenges. Originally discussed in [Section 3.6.3](#) and [Section 4.5.2](#);
3. *context of open documents across platforms* — the inability for most PIM-tools to identify the context of open documents across PIM-platforms was identified to pose challenges to participants of Phase 1 and Phase 2. Originally discussed in [Section 3.6.4](#) and [Section 4.5.3](#);



4. *context of printed documents* —the lack of context related to printed documents maintained by individuals when they later seek to make notes regarding these documents (usually on an iPad) was highlighted as a challenging proposition. Originally discussed in [Section 3.6.4](#) and [Section 4.5.3](#);
5. *inability for PIM-tools to identify duplicate content* —the lack of ability for most common PIM-tools used on the iPad and across other PIM-platforms alongside the iPad (such as Evernote or Dropbox) posed a problem for many participants. Originally discussed in [Section 4.5](#).

It was decided to proceed with three of them: *context of printed documents*, *context of open documents across platforms*, and *emails to self*. Each of the potential candidates that was identified to be built as a prototype is discussed, and justified in the following sections.

The possibility of exploring an iPad software PIM-tool for the support of micronotes (as discussed in [Section 3.4.3](#) and [Section 4.5.4](#)) was strongly considered but was dismissed as it was considered too time consuming a proposition. While such an all-encompassing tool would have likely been possible, it would have been at the loss of the ability to construct three prototypes.

A single, micronote-focused, prototype would have been interesting, but the researcher felt that benefits of exploring three prototypes in the context of the research project better served the study objectives, and better allowed for the exploration of the extended conceptual model. Regardless, the nature of micronote taking and the iPad was flagged as a core component of the case study that was to be conducted as Part 2 of Phase 3 —reported in [Chapter 6](#).

There were a number of other candidates identified throughout Phase 1 and Phase 2 that could have been potential prototypes. However, the five that were identified as viable —and the three that were ultimately built as prototypes —represented an appropriate combination of the following criteria:

- *technical considerations* —considering the state of developer access available for the computing platforms involved in the prototypes —Apple OS X and iOS ([Goldstein et al., 2010](#); [Buttfield-Addison and Manning, 2012](#));
- *design challenges* —able to be assembled and well-presented to users with a minimal amount of visual design or user experience design overhead —the goal of this work was to explore cross-platform iPad-based PIM on a broad scale, not focus on the intricacies of usability or visual design;
- *privacy constraints* —the researcher did not wish to deeply explore the contents of participants' personal information collections.



The three prototypes chosen were specifically selected for the following additional reasons:

- Prototype 1: *context of printed documents* — the most challenging of the three to implement, this was chosen as a very specific cross-platform challenge spanning the iPad, and the two focus platforms of the study. In the typical use case, paper documents were printed from an office computer, and notes were written regarding them on an iPad — all three PIM-platforms are involved. The design and functionality of this is discussed later, in [Section 5.4](#);
- Prototype 2: *emails to self* — Emails sent by participants to themselves was such a commonly reported strategy for handling information transfer between platforms that it simply had to be explored. The design and functionality of this is discussed later, in [Section 5.5](#);
- Prototype 3: *cross-platform open document context* — The stresses and challenges of making sense of moving context between PIM-platforms provided an broad basis for this prototype to explore. The design and functionality of this is discussed later, in [Section 5.6](#).

Each of the prototypes that were chosen, in addition to meeting the criteria noted above, also matched appropriately to the sub-activities of PIM defined by the extended conceptual model developed during this research (the extension of [Barreau, 1995](#)).

### 5.3.2 Implementation

This section provides details on the technical implementation of the prototypes discussed in this chapter, a justification regarding the choice of implementation platform, brief commentary on how it may have impacted the results of the work, and a summary of the automatic data logging features included in the prototypes.

The prototypes were developed for the Apple iOS (for the iPad) and Mac OS X (the office computer) platforms, as shown in [Figure 5.2](#). Development was carried out on the Apple Mac OS X desktop operating system, using the language Objective-C and the Cocoa Touch framework. The Apple Mac OS X operating system was selected due to the researcher's familiarity with the software development environment for the platform ([Goldstein et al., 2010](#); [Buttfield-Addison and Manning, 2012](#)). Whilst Mac OS X does not maintain a dominant marketshare of desktop or laptop computers, the range of potential participants willing and available to participate in studies and evaluations based around the prototype who ran Mac OS X was significant.



**Figure 5.2:** *Platforms targeted by the prototypes, iOS (upper) and OS X (lower)*

From a pragmatic software development perspective, the prototype was also designed to be straightforward to implement —simple implementations can assist in making a tool robust, inspiring users to trust it with their information (Hunt and Thomas, 2000). Server components of prototypes —targeted at the office computer —were capable of running on Apple Mac OS X v10.7. Client components of prototypes —targeted at the iPad —were capable of running on iOS v5.0 and above.

Private repositories on the industry-standard source-code management service, GitHub (Lanubile et al., 2010), were used to maintain the prototype's source code during development. The researcher was the sole author, designer, and engineer for prototype development.

### 5.3.3 Automatic Data Logging

Prototypes made significant use of mediated data collection —that is, automatic data logging —as suggested by Hagen et al. (2005), automatic logging is a useful data collection method, with a few caveats. They are:

- time consuming parsing of the resulting (potentially vast) collection of data (Curtis et al., 2002; Fitton et al., 2004);



- lack of context to the data collected ([Curtis et al., 2002](#); [Fitton et al., 2004](#)).

The log files were stored in comma-separated value (CSV) form. Examples of the output of both the background daemons and the iPad clients are shown in [Figure 5.3](#) and [Figure 5.4](#) respectively.

```
ca39f02b502f77892dbde9fa76aa83953d85a704,1358917240,print,pdf
bdb1edb984ce769655a495ccf21563dbc72e3394,1358917359,print,pdf
1e2ee9c8d57223529304caa5734b5ac021eb5e3e,1356785640,print,docx
```

**Figure 5.3:** *Example of the log generated by one of the desktop background daemon components*

The SHA1 secure hash algorithm ([Eastlake and Jones, 2001](#)) was used to encode the identity of specific files used by participants.<sup>1</sup> This allowed unique files to be identified repeatedly, without the researcher having access to the filename or contents of the file. UNIX timestamps were used to log the time of events, as they allowed for straightforward representation of time as a single number ([Thompson and Ritchie, 1978](#)).

The columns used in the background daemon log file shown in [Figure 5.3](#) are: *SHA1 hash of the filename, UNIX timestamp of event, type of event, format of file*. The columns used in the iPad client log file shown in [Figure 5.4](#) are: *SHA1 hash of the filename, UNIX timestamp of event, type of event*.

```
1e2ee9c8d57223529304caa5734b5ac021eb5e3e,1358917442,read_ipad
1e2ee9c8d57223529304caa5734b5ac021eb5e3e,1358917466,read_ipad
1e2ee9c8d57223529304caa5734b5ac021eb5e3e,1358917475,read_ipad
```

**Figure 5.4:** *Example of the log generated by one of the iPad clients*

The discussion of each prototype, below, notes the specifics of automatic data logging carried by each of them. The use of automatic data logging in the prototypes was strongly inspired by [Jones's \(2012\)](#) suggestion that incidental data collection, as a by-product of the daily use of information and PIM-tools, can be a valuable source of data that can be leveraged to improve PIM.

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<sup>1</sup>At least, the researcher assumes that it remains secure, following recent NSA-related revelations.



### 5.3.4 Challenges

The most significant implementation challenge of the prototypes was building the functionality that allowed such deep access to the calendars, email, and printing system of the computers that were running the server component. With the exception of the calendar —which has access provided by the Cocoa frameworks of Mac OS X (Buttfield-Addison and Manning, 2012) —access was gained through the use of the AppleScript system scripting service, which allowed for access to other applications states and data (Singh, 2007; Buttfield-Addison and Manning, 2012). The limitations of this approach were as follows:

- *Prototype 1* was not able to capture documents that were printed to PDF files, instead of to a printer —this was considered a positive by the researcher for the purposes of the prototype, since these documents were not actually printed to physical paper;
- *Prototype 2* was only able to function alongside with the Apple Mail.app or Microsoft Outlook email clients;
- *Prototype 3* was not able to capture the status of documents that were open in applications based on the legacy Mac OS development framework, "Carbon" (Singh, 2007).

It was decided by the researcher that these limitations were acceptable and posed little problem to the overall goals of the prototype development. Chapter 3 reported that PDF documents are typically treated quite differently from printed documents, a breadth of potential participants who utilised the Mail.app and Outlook as mail clients was available, and few Mac OS applications that were likely to be used by participants made use of the Carbon (Singh, 2007).

## 5.4 Prototype 1: Printed Documents Context

This section describes the first prototype focus: addressing the challenges of maintaining context after printing a document. The empirical and methodological design rationale behind this focus is presented, and the capabilities and implementation of the software PIM-tool prototype to address the problem is presented.

Many participants in Phase 1 and Phase 2 suggested that they had significant trouble identifying or remembering the context of a printed document after they had printed it. The following exploratory study participant quote illustrates a typical scenario around printed documents discussed by participants in the exploratory study of Chapter 4 (and to a lesser extent in Chapter 3):

*"... printing something usually ends in stress because I usually print moments before I head to a meeting or some sort of event, and while I'm there the document I printed is of paramount importance but when I get back to my office afterwards, it ends up floating around my desk and days later I have no idea what I printed it for or when I printed it, and then I don't know if I need to keep it around or what its current relevance is!"*

Another typical scenario is encapsulated in this participant quote, also from the Phase 2 exploratory study:

*"I use my iPad to write up a lot of notes about documents I've printed, so I'll be sitting at a coffee shop for example, with my printouts in front of me and I'll start making notes about them but I often have absolutely no idea which meeting, event, or sometimes even project they're from or what I was thinking when I printed them."*

The researcher's proposed solution to address this problem was a software tool—for the office computer—that automatically logs all documents printed by the user from their office computer, storing the specific version of the file that was printed, where it was printed from, when it was printed, and any calendar events that might be related to the document. An iPad-based counterpart to this tool would then allow for the browsing or search of the documents that had been printed.

A prototype was developed for Apple Mac OS X and iOS, using Xcode and Cocoa, allowing for this functionality; a screen from this proof of concept is shown in [Figure 5.5](#).

#### 5.4.1 Design Rationale

The exploratory study reported on in [Chapter 4](#) reinforced the requirement for cross-platform PIM tools to support the maintenance of context when moving between platforms. Providing users with an easier way, indeed a way at all, to keep track of printed documents in relation to other aspects of their personal information space appeared to be a valid and achievable goal for prototyping. Key findings from the pilot study and exploratory study that support this are:

- 60 of the 92 semi-structured interview participants in the pilot study reported that they had trouble identifying and remembering the context of documents that they had printed from their desktop computer, particularly in situations where they needed to use both printed paper documents and their tablet;
- 42 of the 64 semi-structured interview participants in the exploratory study reported the same;



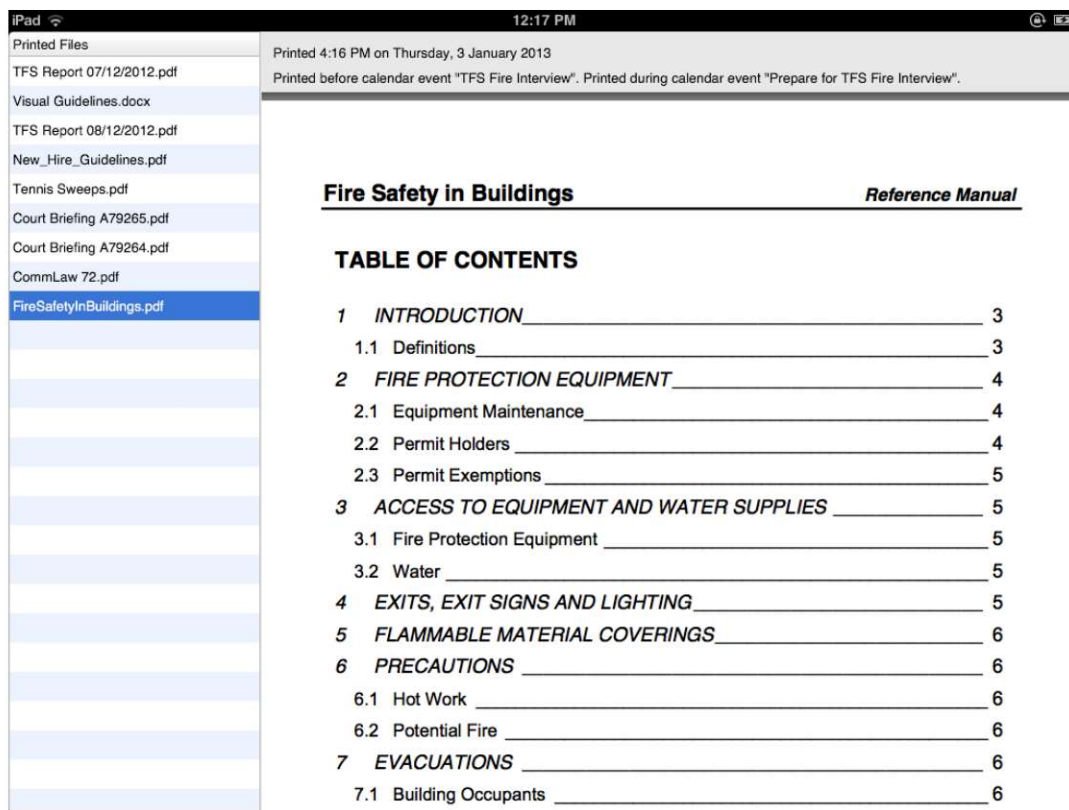


Figure 5.5: An example screenshot from the iPad client of the printed document context prototype

- many participants across all components of both the pilot and the exploratory study reported that they felt knowing the context — which they typically defined as the file name and time of printing — for which they printed something helped them better utilise both the printed document and any notes or use they may make from it;
- a large number of participants in both the pilot and exploratory study reported that they attempted to work around the challenge of maintaining context with printed documents by making a list, using the tablet, of the documents they had printed.

Naturally, the exploratory study also provided some evidence that automated context collection for printed documents might not be useful — the overhead of maintaining their personal information collection was a frequent topic of discussion for participants and more PIM-tools *merely* to keep track of printed documents may offer more trouble than it is worth.

An implementation of context collection for printed documents was envisaged as a research vehicle to investigate the potential of increased integration between physical-PIM and electronic-PIM. The following issues were identified as key for this cross-



platform exploration:

- How would users respond to the automatically collected data-set of printed documents and their context?
- Does the context of printed documents carry meaning relevant to later PIM activities?
- Do users really need this context to be more effective managers of their personal information?

The subsequent implementation and evaluation of a context collection for printed documents PIM-tool prototype was directed at investigating whether this feature would help users manage information across multiple platforms (in this case paper and any electronic platform) more effectively.

Context-collection for printed documents is a valid route for prototype construction for the following reasons:

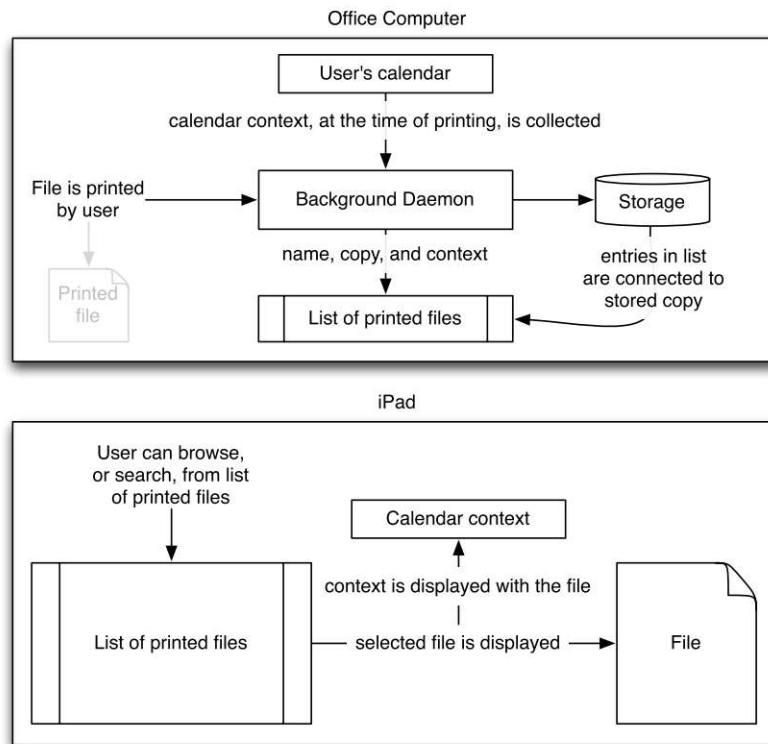
1. There are very few barriers to entry for users of a context-collection for printed documents tool —since the software tool can be connected with the underlying operating system's printing layer, a user does not have to alter their behaviour in order to cause the PIM-tool to be able to collect the context of a document.
2. Many people already use software PIM-tools that are capable of collecting and presenting the necessary structured information and meta-data —logging the information collected about a users' printed documents to a tool they were already using, such as Evernote, further reduces the barrier to entry while also making the implementation of a context-collection system for printed documents a practical and pragmatic choice, given time and software engineering constraints.

### **5.4.2 Capabilities**

In this section, the context-collection for printed documents design is outlined in detail. The capabilities of the PIM-tool for context-collection of printed documents is as follows:

- Automatic logging of the fact that a file was printed —if a user prints a document, an entry representing this printing should be created.
- Automatic logging of meta-data related to the printing of a file —the time and date of printing, a copy of the specific version of the file that was printed, and possibly other meta-data, should be stored alongside the entry representing the printing.

- Ability for a user to browse, sort, and search the entries representing documents that they have printed.



**Figure 5.6:** The functionality of Prototype 1, the iPad software PIM-tool for context-collection of printed documents

The functionality of this prototype is illustrated in Figure 5.6. The prototype was designed to meet the basic requirements, as derived from participant responses from Phase 1 and Phase 2, documented in earlier, in Section 5.4.

### 5.4.3 Usage Scenarios

Several scenarios, based on participant comments in the exploratory study, were developed in order to explore and illustrate how a PIM-tool for the context-collection of printed documents might be used:

- printing documents, attending a meeting, then having to followup using those printed documents after the meeting;
- printing documents and then having to open and make tweaks to the source document files on a tablet during the meeting;
- taking digital notes from a previously printed set of paper documents;

These scenarios were developed based on exploratory study participants' discussions of the most common times in which they printed something from the office computer, for later use of the paper alongside the iPad. Participants in the exploratory study noted:

*"I usually print documents prior to walking to a meeting room, and after the meeting I have a lot of trouble following up with meeting participants regarding the contents of those documents because I need to spend time figuring out what the hell I printed in the first place so I can update it, or make notes as necessary."*

*"Printing documents is a huge pain in the arse, since after I pass them around with whoever I'm working with or meeting I end up getting asked to make tweaks. I usually have my iPad in the meeting, so I can do that, but it takes time to find and open the damn file I need in the first place, if I even have that file accessible on my iPad."*

## 5.5 Prototype 2: Emailing Yourself

This section describes the second design focus: addressing the challenges of keeping track of, and successfully making use of, emails sent to oneself. The empirical and methodological design rationale behind this focus is presented, and the capabilities and implementation of the software PIM-tool prototype to address the problem is presented.

Participants in the exploratory study reported, almost en masse, that they emailed notes to themselves on an extremely regular basis. The following exploratory study participant quote illustrates this behaviour:

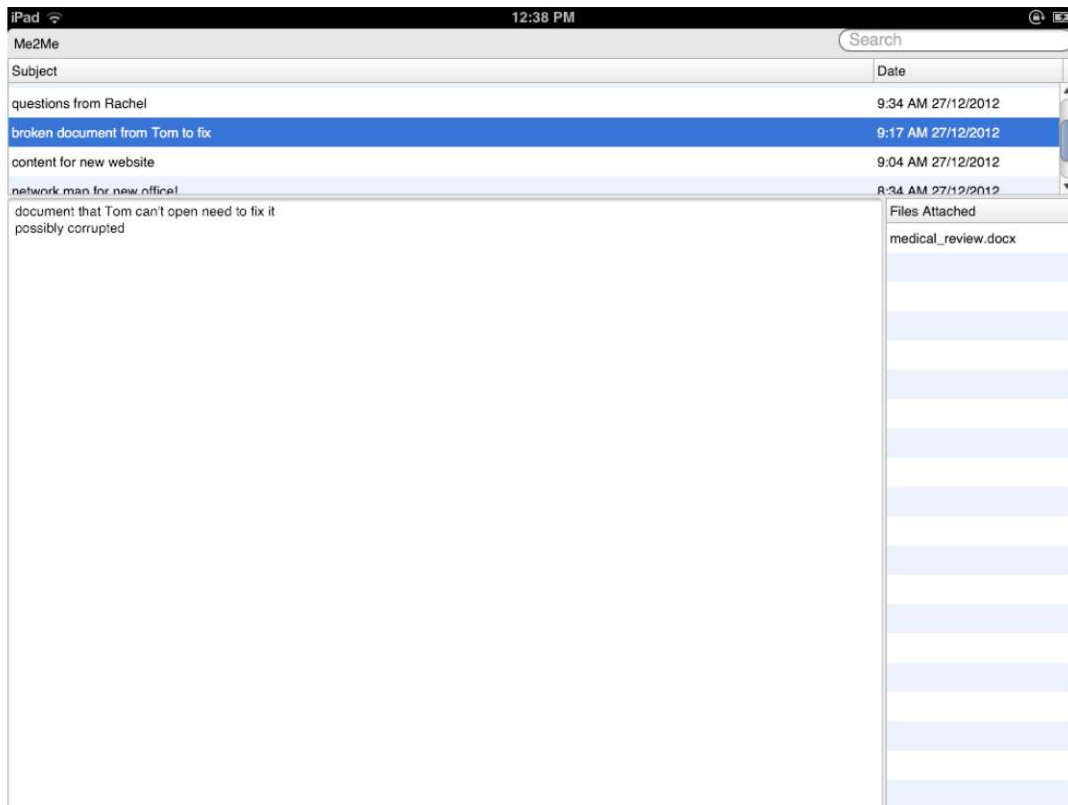
*"Emailing stuff to myself is my default way of synchronising a note from my phone to my computer and vice versa. I'd be lost without the ability to do this!"*

As often as they praised the ability to email themselves notes, participants in the exploratory study also noted that it frequently caused them great organisational annoyance and stress. The following exploratory study participant quote shows this common observation:

*"It's so convenient to email myself stuff, but it causes havoc with my inbox. The mixture of emails and random notes from myself just gets ridiculous and I often find myself only actioning notes from myself when I get around to cleaning up my inbox because the inbox gets filled with real emails before I remember or notice the notes from myself."*



The proposed solution to assist with this problem was a software tool that automatically filters and logs emails from the user to the user in a regular note-taking application (rather than in their email client). An initial proof of concept prototype was developed for Apple Mac OS X using Xcode and Cocoa, and allowing for the emails to be logged into the popular Evernote note-taking application. A screen from this proof of concept is shown in [Figure 5.7](#).



**Figure 5.7:** An example screenshot from the iPad client of the second prototype

### 5.5.1 Design Rationale

The exploratory study reported on in [Chapter 4](#) strongly suggests that providing users with a more effective means of transferring information between platforms was a necessity for future cross-platform PIM tools. Providing users with a way to keep track of, and filter, emails sent from themselves to themselves — separate to managing their emails via their typical email client — appeared to be a useful and relevant starting point. Key findings from the exploratory study, as well as observations in general that support this, are:

- this prototype works alongside an existing PIM-tool —email —and, beyond the use of the application developed for browsing emails sent to yourself, did not

require the adoption or integration of a new PIM-tool into participants' PIM habits;

- emailing oneself was the most prevalent strategy used by participants in the pilot study to transfer information from their office computer to the iPad, with every participant in the semi-structured interview component reporting that they did this;
- similarly, a large number of participants in the exploratory study reported the same, with the data suggesting more than 50% of online questionnaire participants did this more than 10 times per day;
- participants in both the pilot and exploratory study suggested that emailing themselves information for later consumption on their tablet was a core part PIM activity for them, but that locating those emails and managing them in the future was challenging as "*regular*" emails mounted up around them.

An implementation of a PIM-tool, for the iPad, that would aggregate and allowing the browsing and searching of emails sent to yourself was envisaged as an excellent research vehicle with which to investigate the usefulness of addressing this problem, the effectiveness of this particular approach, and the potential to cross PIM-platform boundaries in a manner more suited to individuals' actual behaviours. The following issues were identified as key for this cross-platform exploration:

- Does quicker access to the emails sent to yourself having a meaningful impact on the ease of PIM?
- Is using a dedicated PIM-tool for managing emails sent to yourself better than using an email client?
- Is an iPad PIM-tool designed for capturing emails to yourself a better solution than a new means of transferring information from a computer to an iPad, or existing web services offering file transfer (i.e. Dropbox)?

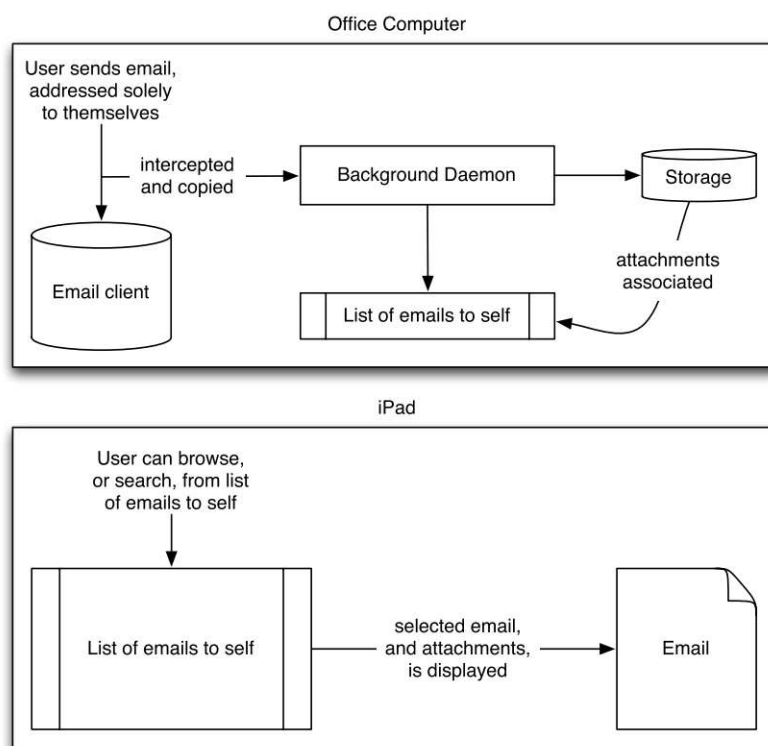
Automated filtering of emails sent from and to oneself is a valid route for prototype construction for the following reasons:

1. it meets the requirements, previously noted in [Section 5.3.1](#), of being an achievable technical challenge, an achievable design challenge, and achievable within the privacy constraints of the work
2. addresses a particularly vehement set of observations from Phase 1 and Phase 2 study participants

3. relates to multiple areas of the proposed evolution to the conceptual model of PIM proposed earlier, allowing for a deeper discussion of the prototype and the results from its evaluation, as well as evaluation and consideration of the evolved conceptual model

### 5.5.2 Capabilities

In this section, the automated filtering of emails sent from and to oneself prototype design is outlined in detail. The capabilities of this prototype were:



**Figure 5.8:** The functionality of Prototype 2, the software PIM-tool for automated filtering of emails sent from and to oneself

- the automatic capture of emails sent to the participant's own email address, sent via their desktop email client on their primary office computer, and storage into a local database — stored on the office computer — with hooks to allow remote retrieval via an iPad counterpart application
- the ability to browse by date and subject, and search, all captured emails via an iPad application that retrieved data via the office wireless network

The functionality of this prototype is illustrated in [Figure 5.8](#). The prototype was designed to meet the basic requirements, as derived from participant responses from



Phase 1 and Phase 2, documented earlier in [Section 5.5](#).

### 5.5.3 Usage Scenarios

A number of scenarios were developed to illustrate how this prototype might fit into the daily workflows of participants from the pilot and exploratory studies. Naturally, these usage scenarios are not an exhaustive representation of how this prototype might be used, but rather provide a sample of the manner of challenge, or situation, in which the prototype may prove effective ([Alexander and Beus-Dukic, 2009](#)). The scenarios developed around Prototype 2 were:

- emailing of prepared meeting notes (for personal consumption) to oneself prior to attending the meeting;
- emailing of a collection of documents, as attachments, to oneself, along with a few notes on the content of the documents in the body of the email, to oneself prior to attending a meeting or for future reference;
- emailing oneself some notes as a reminder for an activity that requires attention in the future.

These scenarios were developed primarily based on exploratory study participants' discussions of the most common occasions in which they emailed themselves something from the office computer, for later use on the iPad. Participants in the exploratory study noted:

*"I always email myself a bunch of notes prior to each meeting, so I have them on my iPad for reference at the meeting. Sometimes I attach documents that I'll need to refer to during the meeting so I have easy access to them."*

*"Emailing myself is my dirty secret. I do it so that future-me can be reminded of stuff that requires me to do it in the future."*

## 5.6 Prototype 3: Open-document Context

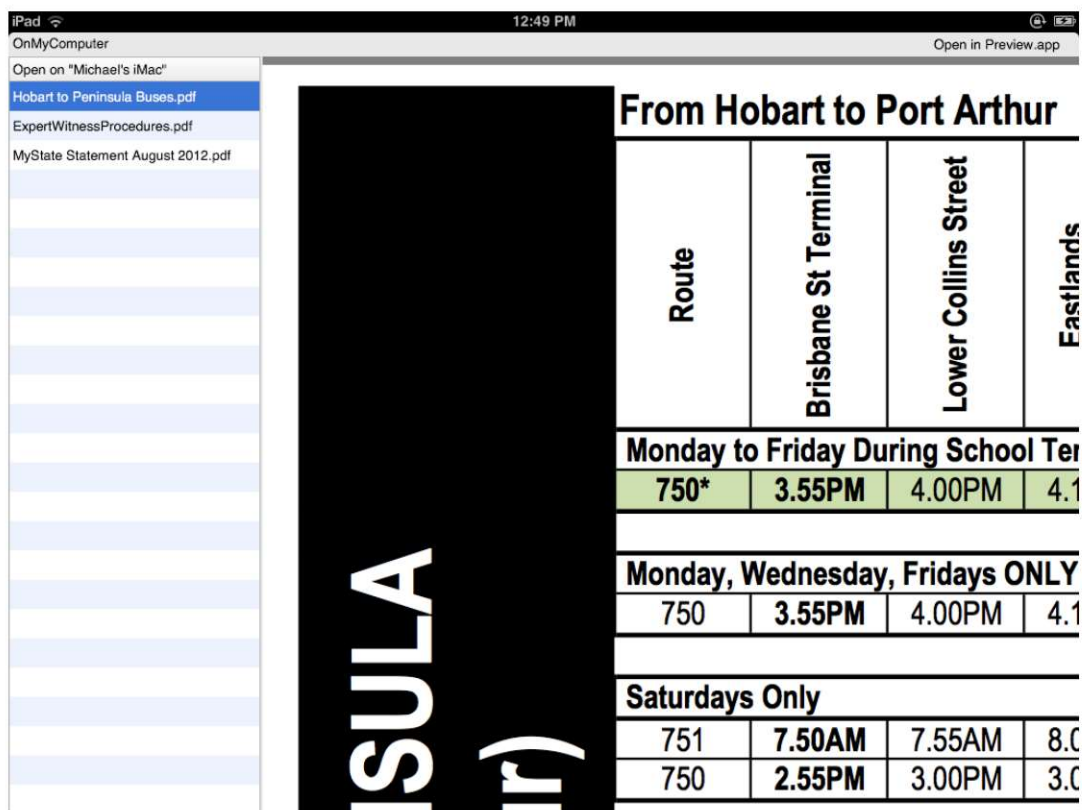
This section describes the third design focus: preserving the context of the office computer between devices. The empirical and methodological design rationale behind this focus is presented, and the capabilities and implementation of the software PIM-tool prototype to address the problem is presented.

A similarly frequently-reported issue from the exploratory study was the challenge of maintaining context when moving between different computing devices, for

example: moving from one's office computer to a meeting, using an iPad at the meeting. The following exploratory study participant quote exemplifies this issue:

*"I prepare for my meetings by reading relevant documents on my office Mac, and then head off to the meeting with my iPad. When I'm in the meeting I then get distracted and have to spend time going through the emails or documents on my iPad to bring up the material I need in the meeting."*

The proposed solution to assist with this problem was a software PIM-tool that runs on both the office computer and the iPad, allowing the user to instantly review the most recent, and currently, open documents and emails from their office computer on their iPad. An initial proof of concept was developed for Apple Mac OS X (for the office computer) and Apple iOS (for the iPad), using Xcode and Cocoa. A screen from this proof of concept is shown in [Figure 5.9](#).



**Figure 5.9:** The iPad-view of the recent documents prototype proof of concept

### 5.6.1 Design Rationale

As with Prototype 1, the exploratory study reported on in [Chapter 4](#) strongly suggests that providing users with means to support the maintenance of context when moving

between platforms would be beneficial in future PIM-tool development. Providing users with a way to keep track of the documents that were open on their office computers when they moved to their tablets therefore seemed to be a valid and achievable goal for prototyping. Key findings from the exploratory study that support this are:

- 40 of the 92 semi-structured interview participants in the pilot study reported the maintaining context from the documents they were working with on their office computer when moving to their iPad was a significant problem;
- 37 of the 64 semi-structured interview participants in the exploratory study reported likewise;
- participants in the pilot study and exploratory study reporting working around this challenge by making lists, so they could re-open the same documents to the same location when they moved to another platform, such as their tablet;

Providing the context of documents open on the office computer is a valid route of prototype construction for the following reasons:

1. it meets the requirements, previously noted in [Section 5.3.1](#), of being an achievable technical challenge, an achievable design challenge, and achievable within the privacy constraints of the work;
2. it addresses a particularly vehement set of observations from Phase 1 and Phase 2 study participants;
3. relates to multiple areas of the proposed evolution to the conceptual model of PIM proposed earlier, allowing for a deeper discussion of the prototype and the results from its evaluation, as well as evaluation and consideration of the evolved conceptual model.

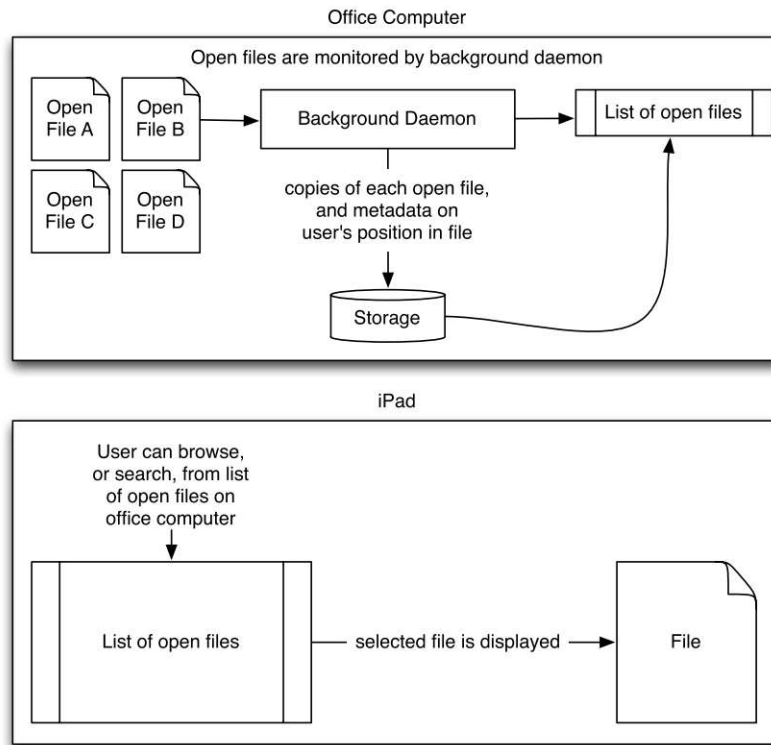
### 5.6.2 Capabilities

In this section, the preservation of document context from the office computer to other devices prototype design is outlined and detailed. Specifically, the capabilities of this prototype were:

- the automatic capture of all documents open in applications on the participant's primary office computer, storage of the document and the participant's position in the document into a local database, with hooks to allow remote retrieval via an iPad counterpart application



- the ability to browse by filename and application, all captured documents via an iPad application that retrieved data via the office wireless network



**Figure 5.10:** The functionality of Prototype 3, the software PIM-tool for preserving open document context from the office computer

The functionality of this prototype is illustrated in [Figure 5.10](#). The prototype was designed to meet the basic requirements, as derived from participant responses from Phase 1 and Phase 2, documented in earlier, in [Section 5.6](#).

### 5.6.3 Usage Scenarios

Several scenarios, based on participant comments in the exploratory study and pilot study, were developed in order to explore and illustrate how a PIM-tool to support open-document context might be used:

- maintaining context with in-use digital documents when moving from a desktop computer to a tablet, often to attend a meeting;
- preparing for a project by grouping related, but otherwise separated documents together in open windows and attempting to re-open that collection on a tablet.

These scenarios were developed based on participant discussions. For example, participants in the exploratory study noted:

*"I usually have a trouble figuring out or remembering what I was reading on my computer and why when I get out of my office and need to get those documents back up on my iPad or something."*

*"I prepare projects, or meetings, by opening all the relevant files on my computer. Later on, I find it hard to remember or figure out exactly what files I had open when I attempt to recreate that on my iPad."*

## 5.7 Initial Evaluation

Prior to the three prototypes being declared robust and ready for deployment, it was decided that it was prudent to conduct an initial evaluation of the prototypes. This initial evaluation was focused on exposing critical issues with the prototypes' design, identify any significant bugs, and address a number of design questions, for each prototype:

- Does the interface provide sufficient access to the features of the prototype such that it can fulfil its capabilities to the user?
- Are there any unforeseen technical challenges to the smooth operation of the prototype?
- Do the prototypes smoothly operate with their proposed feature set?

The methodologies employed for the initial evaluation of the prototypes were drawn from industry standard software engineering user tests ([Pressman and Ince, 1992](#)); the use of such techniques was previously discussed in [Section 2.3.4](#). The results of the initial evaluation were largely sought to improve the prototypes such that they would be extremely viable for their exploration and evaluation, and were not directly intended to contribute to the outcomes of the thesis.

There were 10 participants for the initial evaluation; their details are presented in [Table 5.1](#). All participants were knowledge workers, and utilised an iPad.

The initial evaluation proceeded as follows: all three prototypes were installed on participant's primary office computer, and on their iPad. The researcher introduced them to the functionality of the prototypes, provided a brief walkthrough, and gave the participants an opportunity to ask any questions they had. Participants were then asked to make use of the prototypes over a period of one business week (five days), and provide feedback on any aspect of the design and functionality during a semi-structured interview at the conclusion of the week. Data was collected in the form of notes made by the researcher.

	Gender	Age	Profession
P1	Female	42	Nurse
P2	Female	29	Lawyer
P3	Male	26	Software Engineer
P4	Female	29	Teacher
P5	Male	33	Teacher
P6	Male	39	Lawyer
P7	Female	45	Teacher
P8	Male	39	Architect
P9	Male	37	Doctor
P10	Male	39	Lawyer

**Table 5.1:** Participants in the initial evaluation of the prototypes [ $n=10$ ]

The initial evaluation was approved as a Minimal Risk Study (H0012983), as part of the approval for the entirety of Phase 3, by the Tasmanian Human Research Ethics Committee.

### 5.7.1 Results

The prototypes were used heavily by participants in the initial evaluation. Several of the recommendations and requests made by participants in this initial evaluation were developed and incorporated into the prototypes prior to the main evaluation reported on in [Chapter 6](#). The design recommendations and feature requests acted upon were:

- *printing prototype*: 7 of the 10 participants requested that the prototype provided "at a glance" access to the number of pages in each printed document, as they identified this as a particular contextual cue by which they remembered the use of particular documents.

This feature was implemented through adding a column to the list of printed documents showing the page count for each, as shown in [Figure 5.11](#).

- *email prototype*: 8 of the 10 participants requested that the email prototype collected a similar set of contextual data as the printing prototype did. Specifically, most requested that the calendar data that was collected by the printing prototype was also collected by the email prototype.

This feature was implemented in the same manner as it is presented in the printing prototype, as shown in [Figure 5.12](#).

- *open-document prototype*: 8 of the 10 participants requested the ability to remotely close documents that were open on their office computer, via the list of open



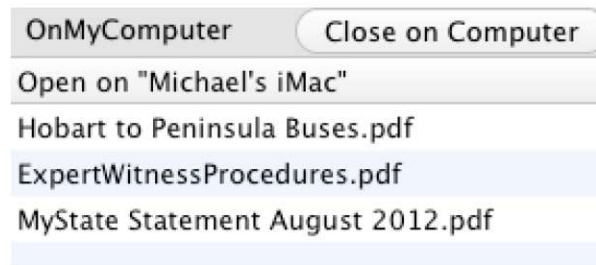
Printed Files	Count
TFS Report 07/12/2012.pdf	3
Visual Guidelines.docx	9
TFS Report 08/12/2012.pdf	3
New_Hire_Guidelines.pdf	4
Tennis Sweeps.pdf	8
Court Briefing A79265.pdf	7
Court Briefing A79264.pdf	1
CommLaw 72.pdf	3
FireSafetyInBuildings.pdf	5

**Figure 5.11:** Page count of printed documents added to Prototype 1

Subject	Date
docs for new website meeting	10:07 AM 28/12/2012
New Employee Setup	4:50 PM 27/12/2012
questions from Rachel	9:34 AM 27/12/2012
broken document from Tom to fix	9:17 AM 27/12/2012
content for new website	9:04 AM 27/12/2012
Sent before calendar event "Planning Meeting". Sent during calendar event "Lunch".	Files Attached
	medical_review.docx
document that Tom can't open need to fix it possibly corrupted	

**Figure 5.12:** Contextual data for emails added to Prototype 2

documents in the iPad app.



**Figure 5.13:** "Close on Computer" button added to Prototype 3

This feature was implemented via the addition of a "Close on Computer" button, with a follow-up confirmation prompt, as shown in [Figure 5.13](#).

Broadly, participants were happy with the access to the capabilities of each prototype, the technical performance of the prototypes, and the usefulness and usability of the features. The following comment, from P7, showcases the prevailing attitude of participants:

*"Yes, I was quite happy with the way they performed. I think they were all roughly equal in utility, and I found no obvious bugs in my use of them. I tried to make use of them very deliberately in the first day or two, but actually found myself using them quite literally and finding them very useful, in the last few days."*

Technically, the prototypes performed exceptionally; in the week of usage by participants, only a single crash was reported, the cause of which was subsequently identified and corrected. The wireless network available in many participants' offices was unsuitable for the robust operation of the prototypes, and in many cases frequent dropouts of the network were logged by the underlying operating systems that prototypes were running on. Steps were taken to increase the hardiness of the prototypes' network code, and repeated retries were introduced to alleviate this problem. The researcher performed a 24 hour stress test of the prototypes on a deliberately sub-standard wireless network following this, and found the performance sufficient.

The initial evaluation reinforced the potential benefits of addressing each of the problems under study. Overall, it was decided to proceed into a case study, utilising all of the prototypes with the suggested enhancements noted above in place. This initial evaluation was solely focused on exposing technical and design issues that would prevent participants from using each for their intended functionality; the following chapter reports on case study during which the prototypes are fully utilised and explored.

## 5.8 Conclusions

This chapter has reviewed the motivation, design, and development of a number of software PIM-tool prototypes. The PIM-tools discussed and developed throughout this chapter all arose from the results of the work shown in [Chapter 3](#) and [Chapter 4](#), as well as the literature reviewed in [Chapter 2](#).

The need to design PIM-tools to be extremely simple was paramount when considering the prototypes that were discussed in this chapter. While the need for simplicity in PIM-tools has been called for multiple times in the past (e.g. [Boardman, 2004](#); [Jones and Teevan, 2007](#)), it seems to have rarely eventuated, as noted in [Chapter 2](#).

The outputs of the prototype design and development can be broken down into the following facets:

- three software PIM-tool prototypes for the Apple iPad platform, designed to target some of the most prevalent facets of cross-platform PIM identified through the pilot and exploratory studies;
- an initial evaluation of the three prototypes, based on standard software engineering testing methodologies, confirming their viability for further exploration and identifying software bugs and usability flaws;
- a number of usage scenarios for each prototype, providing a basis for future evaluation, use, and exploration of the prototypes.

Broadly, the development of the prototypes has fulfilled the initial objectives that it was designed to, as discussed in [Section 5.2.1](#), by:

1. building three prototypes to explore three of the problems faced by individuals practicing cross-platform PIM;
2. performing an initial evaluation of the software PIM-tool prototypes, and providing a number of usage scenarios for each prototype through which future evaluation can be guided.

Similarly, in line with the objectives of the overall research that were discussed in [Section 1.2.1](#), the development of the prototypes has:

1. provided the basis through which a further understanding of cross-platform PIM can be built, through the evaluation and use of the prototypes by future study components in this thesis;
2. provided further basis for continued exploration and development of an empirically-grounded model of cross-platform PIM;

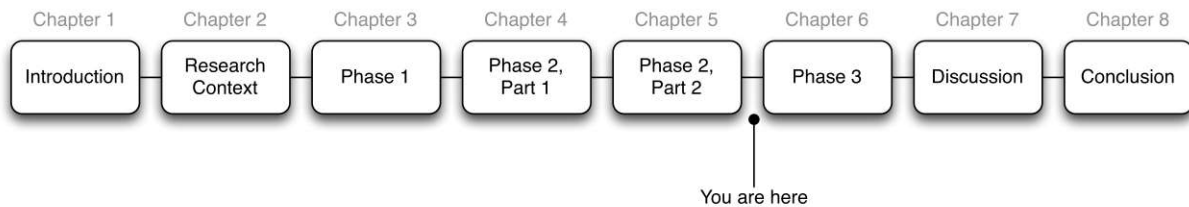


3. directly addressed the third objective by proposing and implementing three software PIM-tool prototypes for the tablet, targeted at addressing three individual problems faced by practitioners of cross-platform PIM.

It is argued that the study reported in this chapter was successful in meeting its objectives; it provides a significant component for the final phase of the research in the form of three software PIM-tool prototypes, and contributes a modicum of additional knowledge with regard to PIM-tool evaluation through the initial evaluation.



[Chapter 6](#), following, presents the main evaluation of the prototypes, as part of a larger case study further exploring cross-platform PIM.



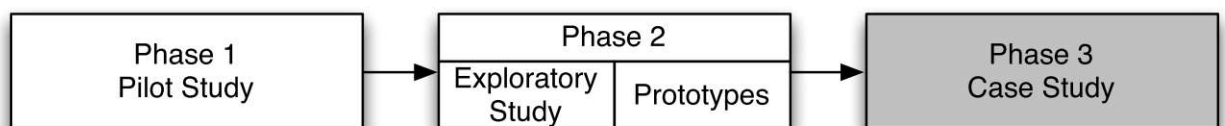
*The trouble with research is that it tells you what people were thinking about yesterday, not tomorrow. It's like driving a car using a rearview mirror.*

—B. Loomis

# 6

## Phase 3: Case Study

THIS chapter reports on a case study of cross-platform PIM, and the use of tablets for PIM, that was conducted amongst a small group of knowledge workers. This study was designed to further explore and develop the conceptual model of cross-platform PIM that was evolved in [Chapter 4](#), explore and evaluate the software PIM-tool prototypes described in [Chapter 5](#), and finalise the observations and recommendations in support of the overall research objectives. The case study involved twelve knowledge worker participants. This case study comprises the entire third phase of the research project. A visual overview of the phases of the research is shown in [Figure 6.1](#).



**Figure 6.1:** *Phase 3: Case Study*

### 6.1 Introduction

This final phase of the research, a case study to further explore cross-platform PIM, and the use of tablets for PIM by knowledge workers, was inspired by past studies of PIM, in which a small —focused— group was employed to great effect (e.g. [Henderson, 2009a](#); [Boardman, 2004](#)). This case study was designed to finish addressing

the overall research objectives, finalise the contributions suggested by the studies reported on in [Chapter 3](#) and [Chapter 4](#), and explore the prototypes described in [Chapter 5](#).

Specifically, this study sought to further develop the evolved conceptual model of cross-platform PIM that was suggested in [Chapter 4](#) by evaluating the prototypes, and collecting specific, detailed information on the facets of the PIM-platforms and PIM-tools involved in the research, and the needs and behaviours of knowledge workers' cross-platform PIM.

This chapter concludes with a summary of each participant in the case study, a discussion on the evaluation of each prototype, and a brief discussion on and the challenges of, and methodologies suitable for, evaluating software PIM-tool prototypes. The findings from the study reported on in this chapter are discussed in an integrated form, with the findings from earlier components of the research, in [Chapter 7](#).

### 6.1.1 Chapter Structure

The presentation of the case study in this chapter is structured as follows:

- [Section 6.2](#) provides an overview of the approach taken, including the objectives of the case study, the choice of methodology, ethics, and the contributions made by the study;
- [Section 6.3](#) discusses the scope, design, participation, and analysis of the case study for each of the six components;
- [Section 6.4](#) discusses the use of the prototypes during the case study, summarising each participants' experience, reporting on the exploration and evaluation of each of the three prototypes, and touching on overall software PIM-tool prototype evaluation methodologies;
- [Section 6.5](#) concludes the chapter with a summary of what has been presented.

It is important to reiterate that the findings from the study reported on in this chapter are primarily discussed in an integrated form, with the findings from earlier components of the research, in [Chapter 7](#).

## 6.2 Approach

The case study was designed to further validate the observations of the research thus far through prototypes exploration and evaluation, additional data collection to finalise the conceptual model, and explore the specific facets and challenges of PIM



that had been identified so far. In past research, there is relative consistency in the ways in which a case study is described, as compared to other naturalistic research methods such as the field study (Wynekoop and Conger, 1992; Kjeldskov and Graham, 2003). The case study implemented here is largely based on a combination of the work of Kjeldskov and Graham (2003) and Yin (2008); the factors that make this a case study are further discussed in Section 6.2.2.

This section, discussing the approach taken for the case study, is structured as follows:

- Section 6.2.1 presents and describes the specific objectives of the case study;
- Section 6.2.2 summarises the data collection tools and research approach of the case study;
- Section 6.2.3 notes the ethical considerations of the case study;
- Section 6.2.4 summarises the contributions to the research made by the case study.

### 6.2.1 Objectives

The overall objective of the case study was to collect specific, detailed information using a variety of data collection tools over a relatively short period of time from a group of knowledge workers.

The information sought revolved around the facets and challenges of knowledge workers' PIM that had been identified in the previous phases of the study. Alongside this, the case study sought to evaluate the iPad software PIM-tool prototypes that were discussed in Chapter 5. Specifically, the three objectives of this case study of knowledge workers' PIM were:

1. *To build and expand on the exploration of the facets and challenges of cross-platform PIM, the use of tablets, and the use of paper, that were identified in the pilot and exploratory studies* — as with the exploratory study, the case study was designed to continue building a deeper understanding of the challenges and facets of cross-platform PIM;
2. *To explore and evaluate the software PIM-tools prototypes* — in support of the overall research objectives regarding software PIM-tool prototypes, the case study was designed to allow for their exploration and evaluation;

3. *To further build upon the conceptual model of cross-platform PIM, using tablets as an exemplar platform* — the case study would provide further data from which a conceptual model of cross-platform PIM, using tablets as an exemplar platform, could be described.

The confluence of a deeper probing of the facets and challenges of knowledge workers' cross-platform PIM identified thus far, together with the evaluation of the prototypes designed to address some of those challenges, would allow for the finalisation and validation of the conceptual model that was introduced in [Section 4.5.5](#).

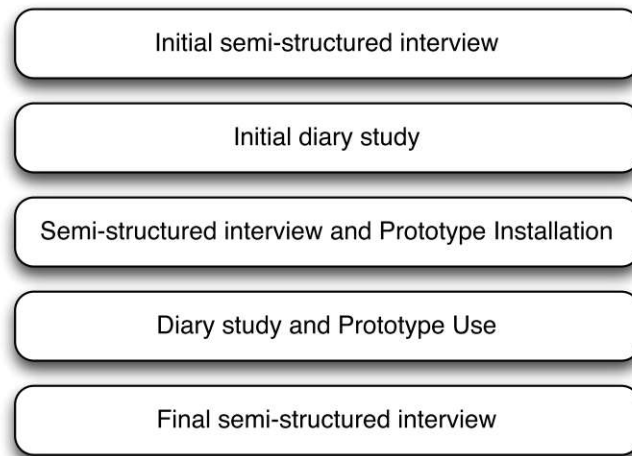
### 6.2.2 Method

To address these objectives a case study consisting of five stages was developed. The various stages were used to triangulate and evolve the researcher's understanding of cross-platform PIM, the prototypes, the evaluation of such prototypes, and the use of tablets for PIM. Specifically, the stages of this study were:

1. an initial semi-structured interview;
2. an initial diary study;
3. a semi-structured interview and prototype installation;
4. a diary study whilst using prototypes;
5. a final semi-structured interview.

A visual overview of the tools and stages is shown in [Figure 6.2](#). Each stage of the case study was conducted sequentially for each participant and not all participants took part in the study over precisely the same period of time.

A careful, systematic analysis was crucial for the case study; as noted by [Kjeldskov and Graham \(2003\)](#), the rich, natural, character of the data collected through case studies can often be contradictory and inconsistent, making it especially necessary to conduct a carefully considered analysis. The grounded theory-based approach that was used for the analysis of the semi-structured interviews from the exploratory study, reported on in [Section 4.4.5](#), was used again for the analysis of the data collected during the case study; this is discussed in [Section 6.3.9.2](#). The use of a case study is justified in [Section 6.3.1](#).



**Figure 6.2:** *Case Study: overview of tools and stages*

### 6.2.3 Ethics

The case study described in this chapter was approved as a Minimal Risk Study (H0012983) by the Tasmanian Human Research Ethics Committee. The experimental materials for the case study are available via <http://paris.id.au/>

Additionally, a number of precautions to data handling, procedure and analysis were taken; this was due to the potentially private and sensitive nature of participants' personal information. Precautions taken included:

- participants were not required, at any time, to discuss or show, even in passing, an item of personal information that they could not, or did not feel comfortable involving in the study;
- participants were free, at any time prior to the collection of data from them being completed, to withdraw completely from the case study;
- participants were comprehensively informed that no judgements were being made by the researcher upon their organisational skill (or lack thereof!)

### 6.2.4 Contributions

This chapter makes two core contributions to the thesis, reflecting the multipurpose nature of the case study:

1. the final piece of empirically grounded data presented in the thesis, providing the insight needed to assess the validity of the observations made thus far, and finalise the evolved conceptual model of cross-platform PIM under development;



2. the exploration and evaluation of three software PIM-tool prototypes for the iPad, providing the empirical groundwork for general methodological recommendations for the evaluation of software PIM-tools as well as validation of the components of the conceptual model.

At the time of writing, components of the work discussed in this chapter are under review for publication.

## 6.3 Case Study

This section reports on the design and execution of the multi-component case study used for this phase of the research. As noted earlier, a range of data-collection tools were used: semi-structured interviews, diary studies, and automatic software logging. This section also contains passing discussion of findings of the case study.

Multiple data-collection tools were selected in order to build a rich picture of participants' PIM, and the triangulation of data from these tools allowed for deep visibility into participant activities. The stages of the study, and tools used, were:

1. *initial semi-structured interview* — the initial semi-structured interview was designed to build a profile of each participant, and was structurally similar to those conducted during the exploratory study and reported on in [Section 4.4](#);
2. *initial diary study* — the initial diary study, conducted for one week following the conclusion of each participant's initial interview, was designed to provide some characterisation to the behaviour of each participant with regards to the facets of cross-platform PIM that were identified in earlier chapters;
3. *semi-structured interview and prototype installation* — a semi-structured interview was again conducted with participants in the middle of the case study, following their completion of the initial diary study. This interview allowed for additional discussion of the facets of cross-platform PIM, as experienced by them, as well as the installation of the iPad software PIM-tool prototypes. The data from the initial diary study and interview was used as a resource to drive the interview;
4. *diary study whilst using prototypes* — the diary study completed by participants at this point was designed to further characterise participants' experiences with each of the facets of cross-platform PIM. Whilst completing this diary, the prototypes were being used by participants;
5. *final semi-structured interview* — the final stage of the case study involved another semi-structured interview. Participants' experiences with cross-platform PIM,

as well as their experience with the prototypes was discussed. At this point, the prototypes were removed from participants' systems. Data from both diary studies and interviews thus far was used to drive the interview.

The remainder of this section, discussing the design and execution of the case study, is structured as follows:

- [Section 6.3.1](#) justifies the use of a case study;
- [Section 6.3.2](#) discusses the implementation of each specific data-collection tool for the various stages of the case study;
- [Section 6.3.3](#) discusses the participation criteria and sample for the case study;
- each stage of the case study is then discussed in detail:
  - [Section 6.3.4](#) discusses the initial interview;
  - [Section 6.3.5](#) discusses the initial diary study;
  - [Section 6.3.6](#) discusses the interviews and prototype installation;
  - [Section 6.3.7](#) discusses the prototype use and diary study;
  - [Section 6.3.8](#) discusses the final interview.
- [Section 6.3.9](#) concludes this section with a review and justification for the data analysis method used.

Details regarding the experimental materials are also available via <http://paris.id.au/>

### 6.3.1 Choice of Methodology

When exploring how best to serve the objectives noted in [Section 6.2.1](#), and based on the research methods discussed in [Section 2.3](#), two possible options were considered:

1. a case study, or field study-style approach;
2. a controlled study, laboratory-style approach.

The case study approach was ultimately selected as it allowed better access to realistic, routine behaviour, and was more suited to provide a slightly longer term perspective on participants' PIM behaviour than a controlled study might allow ([Kjeldskov and Graham, 2003](#); [Yin, 2008](#)).



A controlled, laboratory-style approach may have yielded more objective data that can be analysed and presented in a quantitative manner, but it has been widely argued that the contrived situations that are often unavoidable in such studies lead to little useful data for real-world behaviours (e.g. [Suchman, 1987](#); [Wixon et al., 1990](#); [Rieman, 1993](#)). It was also felt that a qualitative-focused case study would reveal more natural PIM behaviours and activities ([Jones and Teevan, 2007](#)). The key factors that make this a case study are:

- it is an empirical investigation ([Wynekoop and Conger, 1992](#); [Cheverst et al., 2001](#); [Kjeldskov and Graham, 2003](#); [Yin, 2008](#));
- it utilises a variety of qualitative means, without use of statistical control ([Kjeldskov and Graham, 2003](#));
- it investigates contemporary phenomenon in a natural setting ([Benbasat, 1984](#); [Yin, 2008](#));
- it involves a small group, from a single organisation ([Cheverst et al., 2001](#); [Kjeldskov and Graham, 2003](#));
- the researcher is distinct from the phenomena and field under study ([Cheverst et al., 2001](#); [Kjeldskov and Graham, 2003](#)).

[Kjeldskov and Graham \(2003\)](#) notes that case studies are a particularly useful means of gathering rich data regarding mobile devices in context. The study was therefore a case study, since it was felt that a controlled study was needlessly limiting. The various advantages and disadvantages of field studies, as compared to controlled studies, were discussed in [Section 2.3.1](#). The choice of specific data-collection tools as components of the case study is discussed in the following section, [Section 6.3.2](#).

### 6.3.2 Research Design

This section discusses each specific data-collection tool that was used during this case study. Whilst some tools were utilised for more than one stage during the study, they are only discussed in this section once, as this is a discussion of the tools and not their implementation.

The purpose of the section is to provide an overview of the tools and the reasoning behind the employment of each. The individual data-collection tools used in this study, and discussed in this section, are:

- [Section 6.3.2.1](#) discusses semi-structured interviews;



- [Section 6.3.2.2](#) discusses diary studies;
- [Section 6.3.2.3](#) discusses in-situ prototype installation;
- [Section 6.3.2.4](#) discusses automatic data logging.

Later in this section, beginning with [Section 6.3.4](#), the specific implementation of these tools as stages of the case study is discussed.

#### 6.3.2.1 Semi-structured interview

As with the pilot study reported on in [Chapter 3](#), and the exploratory study reported on in [Chapter 4](#), semi-structured interviews were selected as a data-collection tools for the case study. For a full overview of the reasons semi-structured interviews made an excellent choice for this PIM research, refer to their initial introduction as an tools used in this research in [Section 3.5.1](#), as well as the discussion of data collection tools in [Section 2.3.1](#).

To briefly reiterate, and provide context, the core reasons for using semi-structured interviews in this component of the research —and, indeed, any component of this research —are:

- they are flexible, yet allow for tight focus when needed;
- they allow the exploration of real-world behaviours in a somewhat controlled setting, while avoiding the downsides of a full controlled laboratory study;
- they require relatively minimal time commitment from participants as compared to alternatives such as laboratory studies, diary studies, focus groups and similar methods.

Semi-structured interviews were conducted with participants for the following stages of the case study:

- **Stage 1:** Initial semi-structured interview;
- **Stage 3:** Semi-structured interview and Prototype Installation;
- **Stage 5:** Final semi-structured interview.

The implementation of each set of semi-structured interviews conducted as parts of the case study is reported on in [Section 6.3.4](#), [Section 6.3.6](#), and [Section 6.3.8](#), and as part of the overall discussion of the phases of the case study.

### 6.3.2.2 Diary study

Diary studies were used as a data-collection tool for the first time in the research project in this case study. As noted in [Section 2.3.1](#), diary studies have been used extensively in HCI and PIM research, and allow for the collection of a rich variety of self-reported data. The high ecological value of diary studies comes from the fact that they are conducted in situ, in the real-world environment of the participants ([Czerwinski et al., 2004](#)). Diary studies were used for the following phases of the case study:

- **Stage 2:** Initial diary study;
- **Stage 5:** Diary study whilst using Prototypes.

A significant challenge of a diary study tool for studying personal information management is participants' own bias to reporting details of their habits. Specifically, it has been reported that individuals often omit elements of their PIM habits, because they believe their habits are too mundane or not interesting enough to report ([Elsweiler et al., 2007](#)).

Similarly, diary studies have been observed to sometimes interrupt the practice of the event under study, due to the act of journaling ([Czerwinski et al., 2004](#)). That said, the fact that diary studies minimise the effect of observers on participants has been seen to counteract these things ([Carter and Mankoff, 2005](#)).

Diary studies are often supplemented with pre- and post-study participant interviews, allowing further discussion, evolution, and triangulation of findings ([Ericsson et al., 1990](#); [Rieman, 1993](#)). Similarly, as recommended by [Rieman \(1993\)](#) and others (e.g. [Adler et al., 1998](#); [Kuniavsky, 2001](#); [Sohn et al., 2008](#)), participants are typically only asked to keep a diary for one to two weeks, for fear of overburdening them. This recommendation was incorporated into the design of the diary studies used for the case study. The design of each specific diary study that was conducted as a phase of the case study is reported on later in this chapter in [Section 6.3.5](#) and [Section 6.3.7](#), as part of the overall discussion of the phases of the case study.

### 6.3.2.3 Software prototype evaluation

The conception, design, and development of a number of software prototypes was discussed throughout [Chapter 5](#). These prototypes, naturally, formed a part of the case study discussed in this chapter. Evaluating PIM-tools is a regular sticking point for researchers in the PIM domain ([Boardman, 2004](#); [Jones, 2012, 2013](#)). As was noted in [Section 2.3.4](#), large volumes of discussion on the challenges of PIM-tool evaluation,



the design of methodologies for PIM-tool evaluation, and the general necessity or worthiness of such evaluations have taken place through journal papers, conference papers, and workshops (Kelly and Teevan, 2007; Jones and Teevan, 2007; Jones, 2012).

The prototypes were explored and evaluated using a variety of techniques that were threaded throughout the other tools used for the case study. Specific facets of the prototypes that were sought to be evaluated were: *effectiveness*, *efficiency*, *satisfaction*, and *flow*. Each of these facets are now described in turn. Particular attention is paid to methods for evaluating tools on each of these facets.

Two data sources are used for the evaluation of the software PIM-tool prototypes: logged data, and qualitative feedback. The logged data was gathered through the automatic data logging performed by the prototypes, discussed below in Section 6.3.2.4. Qualitative feedback was collected through the interviews and diaries used at various stages of the case study.

An exploration of each of the facets leads to a strong understanding of how people use a PIM-tool, and goes a long way towards evaluating them (Jones and Teevan, 2007; Jones, 2012).



**Effectiveness** The effectiveness of a tool can be explored by looking at whether users are able to accomplish the tasks the tool is designed to do successfully, and how they feel about their work (Sun and Kantor, 2006; Kelly and Teevan, 2007).

**Efficiency** The efficiency of a tool can be explored by looking at the number of steps required to complete a task, and asking users to discuss the quality of their work (Sun and Kantor, 2006; Kelly and Teevan, 2007).

**Satisfaction** Satisfaction, usefulness, or ease of use can be explored by discussing whether the user felt like their needs were met by the tool (Czerwinski et al., 2001; Kelly and Teevan, 2007).

**Flow** Flow is achieved when users feel they are better able to concentrate on important, rather than mundane, tasks; flow can be looked at with users by exploring how much time they felt was wasted or distracting during PIM tasks (Csikszentmihalyi, 1997; Bederson, 2004; Kelly and Teevan, 2007).

#### 6.3.2.4 Automatic data logging

The final data-collection tool utilised in the case study was the automatic data logging performed by the software prototypes. The data logging features were discussed at an implementation level in Section 5.3.3. This form of data logging, when used as a



research technique, is sometimes referred to as "*mediated data collection*" (Hagen et al., 2005).

The use of mediated data collection in concert with other data collection methods has been reported to be a highly effective way of building towards an in-depth analysis, particularly in relation to mobile technologies such as tablets (Curtis et al., 2002; Hagen et al., 2005). Certain types of data were never collected for privacy reasons. Examples of the type of data that was never collected or transmitted back to the researcher included:

- the entire contents of any piece of personal information that came in contact with a prototype;
- unique identifiers of the participants' devices; for example, a UDID (Buttfield-Addison and Manning, 2012) or phone number;
- any contact, calendar, or similar information stored on the participants' devices.

A number of past PIM studies have attributed the success of their research to the use of a variety of data collection tools in supplement to automatic data logging (e.g. Curtis et al., 2002; Boardman, 2004); broader HCI-related studies likewise (Hagen et al., 2005).

### 6.3.3 Participation

A small group of knowledge workers working at a single location was sought for the case study. This was done as it provided for a relatively closed environment with a wide range of knowledge workers who performed distinct but thematically related work. It was anticipated that working with data from a thematically similar set of workers would make the analysis process smoother (Lazar et al., 2010). The outcomes of this decision are discussed in Section 6.4.1. The choice of specific firm was to be a sample of convenience. The only requirements of participants were that they were knowledge workers who utilised a tablet device for PIM during the conduct of their job.

Twelve knowledge workers took part in the study. The definition of knowledge workers was discussed in Chapter 2 and is largely based on the work of Drucker (1959). Reproduced here for context and convenience, the key things that differentiate knowledge work, and knowledge workers, from other forms of work, and workers, are:

- knowledge workers "*think for a living*" (Davenport, 2005);
- non-routine problem solving, requiring creative, divergent, and convergent thinking (Reinhardt et al., 2011);

- knowledge workers spend a large amount of their working time searching for information; [McDermott \(2005\)](#) suggests that they spend 38% of their time searching for information;
- knowledge workers have large amount of independence and autonomy in defining their own working habits and environment ([Cortada, 1998](#)).

Examples of knowledge workers, as far as the definition used for this thesis is concerned, are: doctors, nurses, lawyers, teachers, architects, and software engineers. This list is far from exhaustive; however, it serves its purposes to demonstrate the nature of the knowledge worker represented in this thesis. [Drucker's \(1959\)](#) definition of a knowledge worker is, broadly: one who works with information, or develops and uses knowledge (from information) in the workplace.

The number of participants means that the results derived from their data will not necessarily apply generally to a worldwide population of knowledge workers; this was anticipated, as the intention here was to develop results to suggest further angles for future research. The number of participants was also in line with past case studies and was supportive of the case study methodology as a whole ([Lazar et al., 2010](#)). None of the participants in the prototype study reported on in this chapter were involved in the earlier studies reported on in [Chapter 3](#) or [Chapter 4](#).

	Gender	Age	Profession	Tablet
P1	Male	28	Legal Secretary	iPad 2
P2	Female	28	IT Support	iPad 3
P3	Male	29	Legal Secretary	iPad 4
P4	Male	62	Lawyer	iPad 4
P5	Male	27	IT Administrator	iPad 3
P6	Female	38	Legal Assistant	iPad 3
P7	Male	42	Lawyer	iPad 2
P8	Male	48	Lawyer	iPad 2
P9	Female	49	Lawyer	iPad 3
P10	Female	42	Lawyer	iPad 2
P11	Female	51	Legal Archivist	iPad 3
P12	Female	28	Legal Assistant	iPad 3

**Table 6.1:** *Participants in the case study [n=12]*

The twelve participants who took part in this study were all employees of a legal and business services firm. As was noted in [Chapter 4](#), the exploratory study had a high proportion of participants from legal occupations — a firm where participants from the previous study were employed was contacted and agreed to participate. To reiterate, though, none of the individual participants in this case study had participated in the pilot or exploratory studies.



The demographics of the case study participants are outlined in [Table 6.1](#), including age, gender, occupation, and type of tablet (all used iPads). As noted earlier, all participants were knowledge workers, and ages ranged from 28 to 62, with the average age of participants being 39.

The privacy precautions outlined in [Section 6.2.3](#) were followed for each component of the study. As the study did not seek to cause participants to feel uncomfortable, participants were informed in advance that they were able to remove any items they did not want the interviewer to encounter (e.g. confidential information, medical reports, etc.) Researcher exposure to content of specific items of personal information was avoided whenever possible. The precautions noted in [Section 6.3.2.4](#) around automatic data logging were also followed.

Additionally, prior to each stage of the case study, the researcher stated the participant's personal approach to managing information was not being evaluated in any way. All participants signed a release form acknowledging that the data would be anonymised before analysis and publication, and no material incentive, financial or otherwise, was offered in return for participation in the study.

#### **6.3.4 Stage 1: Initial Interview**

This section discusses the design and conduct of the initial semi-structured interviews performed as the first stage of the case study. The initial interview was similar in design to those reported on in [Chapter 4](#), conducted as part of the exploratory study. These semi-structured interviews were conducted in order to build an initial understanding of each participant in the case study. This initial understanding allowed the observations and findings from the pilot and exploratory studies to be compared against those derived from the case study.

By approaching the case study in this manner, and building a similar understanding of participants' attitudes, it was confirmed that they were similar to participants from previous phases ([Lazar et al., 2010](#)). The angle the research took was also validated through this approach ([Lazar et al., 2010](#)).

During the initial interview, participants were asked about their PIM practices, their use of a tablet, and experience with the facets of cross-platform PIM identified in [Chapter 3](#) and [Chapter 4](#). Specifically, the techniques employed by participants to transfer and maintain context when using their tablet, and other platforms, in a cross-platform PIM environment were discussed.

Care was taken not to bias participants into discussing problems or techniques that they did not truly use: the researcher did not directly query the previous identified focal points, but rather pressed to discuss them in depth after they arose naturally



during the conversations. Participants were asked to characterise their effectiveness, efficiency, and satisfaction in various facets of PIM, such as acquisition, organisation, maintenance, transferring, contextualisation, and retrieval (van Schaik and Ling, 2005; Kelly and Teevan, 2007).

Participant experiences with *"micronotes"*, and the use of paper alongside the tablet, were also discussed. Consistency with previously reported findings regarding this — such as Section 3.4.3, Section 3.6.6, and Section 4.5.4 — was observed.

Fortuitously, and validating the outcomes of the pilot and exploratory study, previously observed elements of PIM did arise with great frequency. The three scenarios for which the prototypes were designed to explore were discussed with participants; all participants of this case study confirmed that they regularly encountered the problems that the prototypes sought to address.

The initial interviews were carried out in the work environment of the participants and each took between one and two hours. All interviews were digitally audio-recorded and fully transcribed. The researcher spent a cumulative total of twenty-eight full working days conducting and transcribing the initial interviews.

### 6.3.5 Stage 2: Initial diary study

This section discusses the design and conduct of the initial diary study performed as the second stage of the case study. At the conclusion of the initial interview participants were asked to maintain a diary of significant incidents related to cross-platform PIM involving the tablet.

This was intended as a resource that would allow the researcher to characterise their typical PIM behaviour to provide a deeper understanding of the issues, problems, and techniques observed thus far. The diary specifically requested that participants take note of the following situations:

- emails sent from themselves read, or used, on the tablet and sent from their office computer;
- photographs of paper documents taken using the tablet camera;
- problems relating to the context of documents printed from their office computer when using the tablet;
- problems relating to the context of documents left, or recently, open on their office computer when using the tablet;
- experiences with tagging content in tablet software PIM-tools;

- experiences with tablet software PIM-tools and duplicate content.

The diary also requested participants take note of the following broad PIM-related situations:

- experiences transferring information between PIM-platforms, and the reason and means by which they did this;
- challenges in regaining their flow of work or context when moving between PIM-platforms, and their opinions on the reasons for this;
- specific feelings around the user experience of any software PIM-tools that they utilised.

Participants were asked to attempt to update their diary at least twice a day. It was suggested that they update it around the middle of the day and at the end of the day, a practice consistent with similar past use of a diary study tool (e.g. [Adler et al., 1998](#); [Czerwinski et al., 2004](#); [Lazar et al., 2010](#)). Each participant completed this diary study over one working week immediately following the initial interview.

Participants were asked to only keep the diary in relation to their PIM activities in the primary workplace (which was not necessarily solely restricted to their own office). Participants were able to keep the diary in whatever form was most convenient to them. The electronic template that was provided to participants is available via <http://paris.id.au/>

### 6.3.6 Stage 3: Interviews and Prototype Installation

This section discusses the design and conduct of the semi-structured interviews and prototype installation performed as the third stage of the case study. Following the conclusion of the initial diary study, but after an initial analysis of the diary data, participants were again interviewed. This semi-structured interview largely focused on key events that were logged in their diary. Events related to the challenges addressed by the three software PIM-tool prototypes were focused upon. The diary study completed by participants, as well as the transcript from the initial interview, were used as a shared resource during this semi-structured interview ([Lazar et al., 2010](#)).

Near the conclusion of this interview, the three prototypes were installed on the primary office computer and iPad of all participants. Participants were given the opportunity to ask questions regarding any facet of the prototypes, as well as clarify any concerns, privacy-related or otherwise, that they might have. Participants were given the opportunity to withdraw from any or all of the individual prototypes.



The interviews and prototype installations were carried out in the office of each participants and typically took between 30 and 60 minutes. All interviews were digitally audio-recorded and fully transcribed. The researcher spent a cumulative total of twelve full working day conducting these interviews, installing prototypes, and transcribing the recordings.

### **6.3.7 Stage 4: Prototype use and Diary study**

This section discusses the prototype use and diary study performed as the fourth stage of the case study. At the conclusion of the semi-structured interviews and prototype installation, participants were asked to make use of the prototypes for a two week period, while completing a further diary study using the same template as the initial diary study. It was anticipated that participants would expand their reports in the diary to include any effect that the use of prototypes may be having on each facet of PIM being reported on.

Care was taken to point out to participants that they had no need to write favourable things about the prototypes, as the researcher has an equal interest in the prototypes being useful or otherwise. The prototypes were automatically logging throughout the period during which participants used them; the prototypes were all robust and stable, and no crashes were logged.

This diary study was intended to provide an additional tool for data collection through which the findings derived from the semi-structured interviews and the log files generated by the prototypes could be strengthened. They were also intended to gather feedback on the effect of the prototypes on participants' PIM by doing so as close to the moments that they actually made use of them as possible. Additionally, the diary study provided for a data-collection tool that minimised presentation effects, since the researcher was not present during the conduct of the study (Lazar et al., 2010).

Participants were asked to only keep the diary in relation to their PIM activities in the primary workplace, but were not solely restricted to their own office. The diary template that was provided to participants is again available via <http://paris.id.au/>

### **6.3.8 Stage 5: Final interview**

This section discusses the design and conduct of the semi-structured interviews performed as the fifth stage of the case study. The final semi-structured interview involved a discussion of the prototypes, further discussion of participants' cross-platform PIM challenges, and a discussion of their specific, considered thoughts on the proto-



types. At the conclusion of the interview, the software prototypes were removed from participants' iPads and computers.

The diaries from both diary study stages, and the transcripts from both earlier interviews, were used as a shared resource during the semi-structured interviews. The primary focus of this final interview was the solicitation of feedback from participants on the three prototypes and a discussion of key points raised during the participants' diary studies. The overarching themes of the interviews were the challenges of cross-platform PIM, and the use of the prototypes, how they impacted their PIM flow, satisfaction, and effectiveness ([van Schaik and Ling, 2005](#); [Jones and Teevan, 2007](#); [Kelly and Teevan, 2007](#)).

Interviews were carried out in the primary work environment of the participants and each took between one and two hours. All interviews were digitally audio-recorded and fully transcribed. The researcher spent a cumulative total of ten full working day conducting the final interviews and transcribing the recordings.

### 6.3.9 Analysis

This section presents and justifies the data analysis technique used upon the data from the case study:

- [Section 6.3.9.1](#) discusses the log files generated through case study participants' use of the prototypes;
- [Section 6.3.9.2](#) then summarises the qualitative analysis approach used on the data.

An approach based on grounded theory was used to analyse the data. To do this, all semi-structured interview, diary, and logged prototype data was collated into a single spreadsheet-based document per participant. A practice similar to this collation is common in other studies (e.g. [Boardman, 2004](#)).

#### 6.3.9.1 Log Files

A simple analysis of the log files generated by the prototypes was conducted for each participant, and each prototype. The general format and nature of these log files was previously discussed in [Section 5.3.3](#). The particular format of the logs for each of the three prototypes was discussed, for each prototype, in [Section 5.4.2](#), [Section 5.5.2](#), and [Section 5.6.2](#) respectively. An example of the resulting statistics, for an individual participant, from analysis of the log file is shown in [Table 6.2](#).

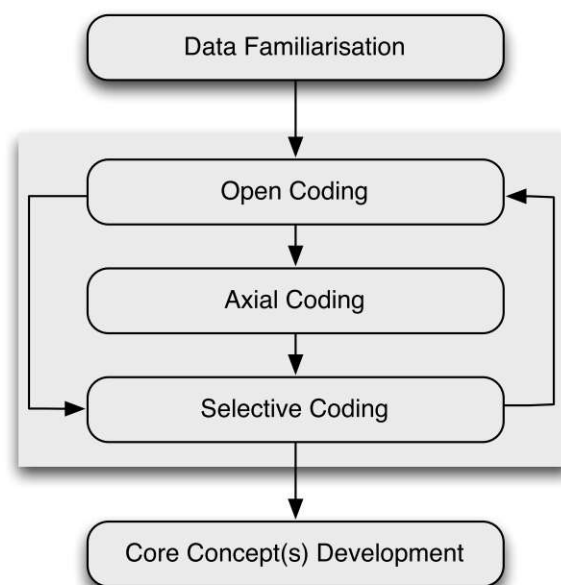
[Section 6.4](#) reports the statistics for each prototype, and uses the statistics collected by the prototypes in its discussion of participant prototype use.

Activity	Participant C
Mean Documents Printed Daily	9
Mean Document Retrievals on iPad Daily	17
Mean Searches Performed on iPad Daily	14
Most Frequent Printed File Formats	PDF, DOCX, RTF

**Table 6.2:** Statistics of prototype usage for Prototype 1 by Participant C of the case study

### 6.3.9.2 Qualitative Analysis

The grounded theory-based approach that was used for the analysis of the semi-structured interview from the exploratory study, reported on in [Section 4.4.5](#), was used again for the analysis of the data collected during the case study. An overview of the analysis process is reproduced in [Figure 6.3](#).



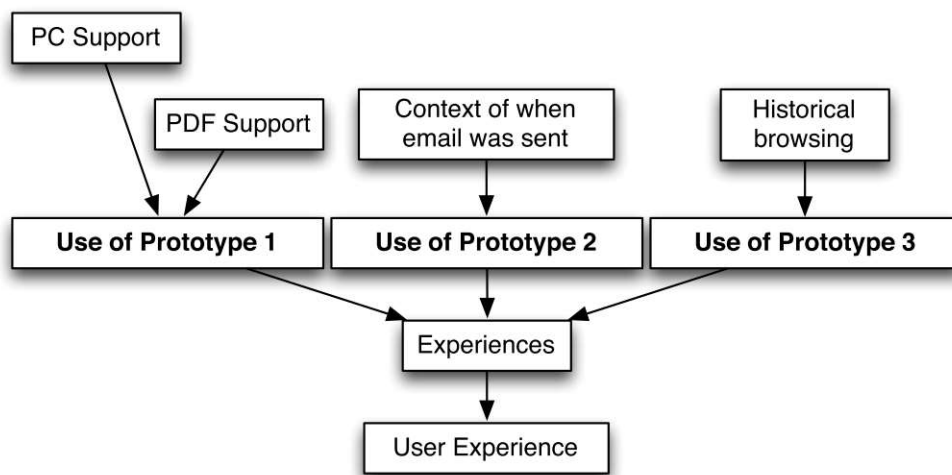
**Figure 6.3:** Phases of the grounded theory-based methodology used

The steps of this approach, which are identical to when it was previously discussed in [Section 4.4.5](#), were:

1. *data familiarisation* — the notation of initial ideas during a review phase to ensure that the researcher had a strong familiarity with the data;
2. *open coding* — open coding involves identifying repeated words and phrases found in the data;
3. *axial coding* — axial coding involves grouping the open codes into categories;

4. *selective coding* — selective coding involves focusing on the most important codes, reviewing those that occur most frequently, or in contrasting patterns (Muller and Kogan, 2010).

As with the exploratory study analysis, every meaningful part of the data was coded (open coding), the relationships between these codes were identified and grouped into categories (axial coding), and the most important codes were identified, expanded, and explained (selective coding). This grounded theory-based approach was used for the data collected during the three semi-structured interview stages and the two diary studies. Analysis was performed on the collated collection of data for each participant, initially on a per-participant level, and then across all participants.



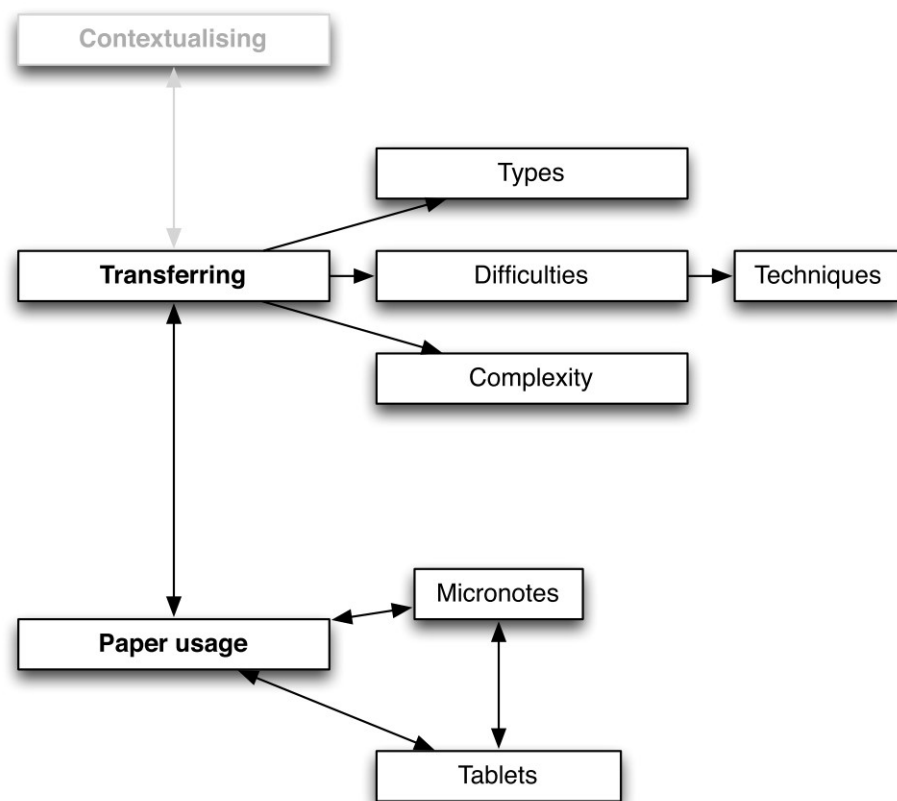
**Figure 6.4:** Examples of codes developed for an individual participant during the various stages of coding at a per-participant level

Examples of codes developed on a per-participant level for each step of the coding are shown in Figure 6.4. Examples of codes developed on an overall level during each coding step are shown in Figure 6.5.

### 6.3.9.3 Core Concepts

The GTM-based coding and analysis process that was performed first across each individual set of data, and then across the data as a whole, gave rise to a number of core concepts. The core concepts revolved around participants' use of prototypes, and — as arose from the exploratory study — around the techniques and challenges of *transferring* information, *contextualising* information, and the use of *paper for micronotes, alongside tablets*. These core concepts are the core of the outputs of the case study, and together form the backbone of the Chapter 7.





**Figure 6.5:** Examples of codes developed in each stage of coding at a holistic level

## 6.4 Use of Prototypes

This section presents an initial discussion on the exploration and evaluation of the prototypes during the case study. An overview of participant use of each prototype is presented, showing participants' attitudes and experiences with each of them, and the evaluation metrics for prototypes that were discussed in [Section 6.3.2.3](#) are explored. Further discussion of the results of the case study takes place throughout [Chapter 7](#), where the findings of the three phases as a whole are combined and discussed; this section does not represent the only discussion of the outputs of the case study.

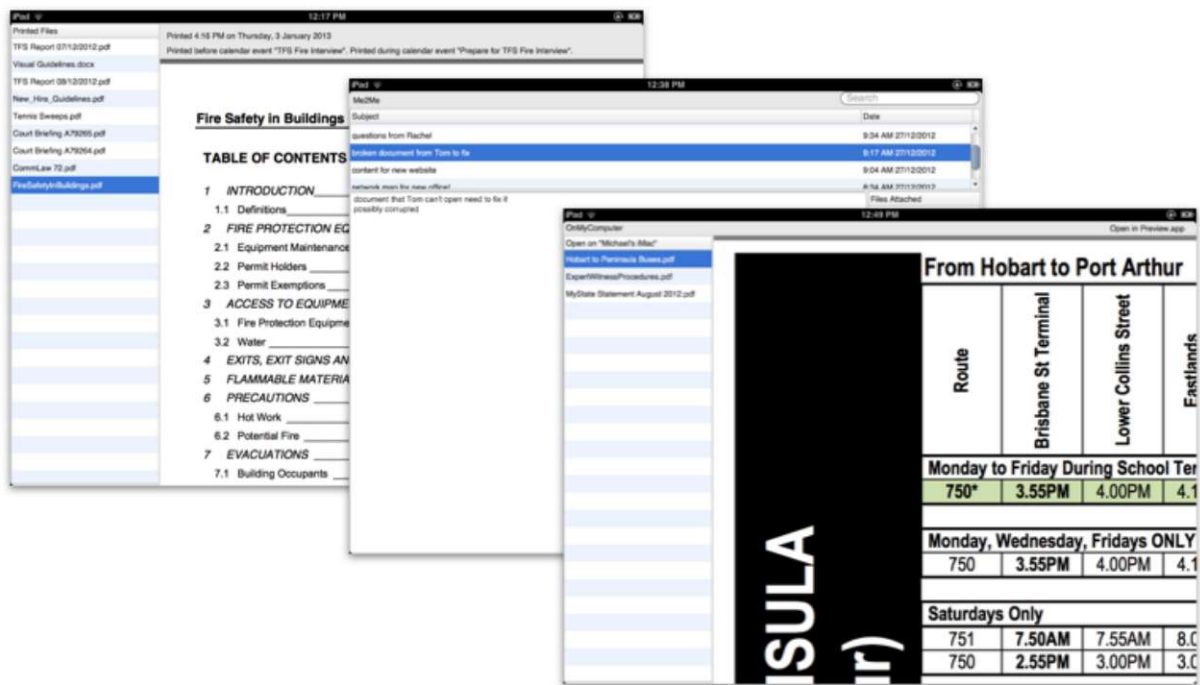


Figure 6.6: The three iPad software PIM-tool prototypes

All three prototypes operated smoothly during the case study. None of the prototypes crashed or behaved in unexpected ways, and the majority of participants reported that they were highly satisfied with their operation. That said, a number of participants used the prototypes in unexpected or unintended ways — this is reported on in [Section 6.4.5](#). The prototypes were used by participants over two working weeks, for a total of ten days.

Two components make up the evaluation of the software PIM-tool prototypes: logged data, and qualitative feedback. The logged data was gathered through the automatic data logging performed by the prototypes, and the qualitative feedback was collected through the interviews and diaries used at various stages of the case

study. This discussion is presented over the following sections:

- [Section 6.4.1](#) provides a brief overview of the activities of each participant;
- [Section 6.4.2](#) reviews the participant experiences and use of the first prototype, the printed documents context tool;
- [Section 6.4.3](#) reviews the participant experiences and use of the second prototype, the tool to support emails sent to yourself;
- [Section 6.4.4](#) reviews the participant experiences and use of the third prototype, the open-document context tool;
- [Section 6.4.5](#) summarises the design recommendations and unanticipated feedback provided by participants.

### 6.4.1 Participant Summaries

There were 12 participants in the case study. This number of participants was excellent when compared to other similar studies and case studies of PIM (e.g. [Whittaker and Hirschberg, 2001](#); [Boardman, 2004](#); [Henderson, 2009a](#)). Behaviour varied in subtle ways between participants, and discussion of each of their experiences adds valuable perspective to the research project.

All twelve participants were active users of the iPad for PIM, making use of the device multiple times on a daily basis. Six of the participants were practicing lawyers, four were in a legal support role, and two worked in information technology (IT). As noted earlier, all were employed by a legal services firm. The fact that all participants were from a single business, and worked in a thematically similar area, was successful —in the opinion of the researcher —in making the analysis process smoother, as it afforded a consistent frame of reference on which to base the exploration of each participants' data-set.

All the participants were extremely open regarding the PIM activities, techniques, and approach. During the semi-structured interview components of the case study, no participants actively restricted access to any aspect of their collections. As was noted in [Section 6.2.3](#), participants were given the opportunity to remove any confidential information, or information that they did not want to the researcher to be able to observe, in advance of their participation in the semi-structured interviews.

A brief summary of the activities of each participant —A to L, twelve in total —and their experiences during the case study is presented below. The specific participants are referred to using pseudonyms in all discussion ([Silverman, 2013](#)).



**A. Jerry —Legal Secretary, Male, aged 28, iPad 2:**

- an iPad user for 3.5 years at the time of participating;
- made significant use of all prototypes;
- particularly favoured Prototype 3, reporting that he found it easier to maintain context between his computer and his iPad in meetings, and ended up having to maintain less paper as a result of not printing documents for meetings.

**B. Sally —IT Support, Female, aged 28, iPad 3:**

- an iPad user for 2.5 years at the time of participating;
- made significant use of all prototypes;
- particularly favoured Prototype 1;
- requested that Prototype 1 have an interface allowing access and search of recently printed files via her office computer, in addition to via her iPad;
- frequently attends planning meeting, and also made extensive use of Prototype 2's ability to provide swift access to her pre-prepared meeting notes, which she had emailed to herself from her computer prior to meetings.

**C. Paul —Legal Secretary, Male, aged 29, iPad 4:**

- an iPad user for 2 years at the time of participating;
- particularly favoured Prototype 3, finding it ability to aggregate a disparate collection of files on iPad that were stored in different locations on his computer by virtue of the fact the files were open on his computer particularly useful;
- also found Prototype 1 useful, as he frequently needed to keep track of document he had printed when he attended meetings.

**D. Denny —Lawyer, Male, aged 62, iPad 4:**

- an iPad user for 3 years at the time of participating;
- particularly favoured Prototype 2 and 3;
- did not find Prototype 1 useful, believing it to offer little more than his manually maintained paper list of printed documents:

*"It's a list of what I've printed, but I can do that by myself. The time taken to make the list doesn't outweigh the time taken to use the tool to find things I've printed. My list was just as effective."*

- his use of Prototype 2 and Prototype 3 was extensive, particularly during meetings, before-which he emailed himself notes and reviewed a number of documents on his office computer (which he was then able to continue reviewing on his iPad, during the meeting).

**E. Brad —IT Administrator, Male, aged 27, iPad 3:**

- an iPad user for 1.5 years at the time of participating;
- found Prototype 2 and Prototype 3 particularly useful;
- saw the value of Prototype 1 but found the user interface hard to use; suggested that the tool should preserve the folder hierarchy of where the printed files were located on the computer, noting that this would help him remember and think about the files more effectively:

*"I think it would be better if the tool showed me where the file was located on the computer and let me browse around that way. That's how I remember and think about the files."*

**F. Denise —Legal Assistant, Female, aged 38, iPad 3:**

- an iPad user for 2 years at the time of participating;
- particularly favoured Prototypes 2 and 3;
- did not find Prototype 1 useful due to the speed at which it updated to display the most recently printed documents:

*"I tried to use it early on, but it hadn't caught up with the things I'd just printed, so I didn't get as much use out of it as I might have otherwise."*

**G. Carl —Lawyer, Male, aged 42, iPad 2:**

- an iPad user for 3 years at the time of participating;
- found Prototype 2 particularly useful, reporting that the ability to *"actually have the emails I send to myself work for me instead of against me"* was particularly invaluable;
- found Prototype 1 and 3 useful.

**H. Alan —Lawyer, Male, aged 48, iPad 2:**

- an iPad user for 3 years at the time of participating;
- found Prototype 1 and 2 useful;
- commented that Prototype 3 was not particularly useful since it *"just replicated the unorganised mess that is the stuff I have open on my computer, but on my iPad"*;
- despite his stated opinions, logs of Alan's usage of Prototype 3 suggest that he made use of it in a similar fashion to the other participants.

**I. Catherine —Lawyer, Female, aged 49, iPad 3:**

- an iPad user for 1 year at the time of participating;
- was particularly struck by the usefulness of Prototype 2, which she reported *"allowed me to stop worrying about never doing the things related to the documents I email myself"*;
- made reasonably significant use of Prototype 1 and 2.

**J. Sara —Lawyer, Female, aged 42, iPad 2:**

- an iPad user for 2.5 years at the time of participating;
- found all the prototypes useful;
- was particularly struck with Prototype 1's search feature, noting that she felt it made her a lot more efficient working with her printed information on a daily basis:

*"It was very useful, I think that I found myself using it without having to remember to after only a day, and it stuck with me. The search was very useful, since I could plug in a few words from whatever printout I was holding in my hand and it would bring up that document almost straight away."*

*"It made me a lot more efficient during meetings since I started to rely on the ability just to bring it right up. If I needed to email someone a copy of something I had on paper I could just call it up and zap it right to them. The way I normally do things is significantly slower."*

**K. Shirley —Lawyer, Female, aged 51, iPad 3:**

- an iPad user for 3 years at the time of participating;



- found Prototype 1 useful, particularly for its search ability, which she used frequently throughout the study;
- made reasonably significant use of Prototype 2 and 3 as well.

**L. Claire, Legal Assistant, Female, aged 28, iPad 2:**

- an iPad user for 2 years at the time of participating;
- was a *"big fan"* of Prototype 2, reporting that it *"made me feel like email was manageable again"*;
- reported that she felt as though the multitudes of emails she would send to herself never got attended to in the *"clutter of the inbox"* and that Prototype 2 allowed to make use of information which *"prior to this app [Prototype 2] was forgotten about"*.

### 6.4.2 Prototype 1: Printed Documents

The first prototype was designed to address the challenges of maintaining context after printing a document. This section summarises participants' experiences with that prototype.

Case study participants collectively printed 852 times whilst using the prototypes. The volume of printing self-reported by participants during the interviews and diary studies prior to participants' use of the prototype was consistent with the amount of printing actually conducted by participants and logged using the prototypes. Printing, and a number of other statistics from participants' use of the prototype, are shown in [Table 6.3](#).

	Across All Participants
Total Documents Printed	852
Total Document Retrievals on iPad	397
Total Searches Performed on iPad	306

**Table 6.3:** Tally of participant use of Prototype 1 during the ten day period

Nine of the twelve participants reported that they found this prototype useful, with three reporting that they did not find it useful. The comments amongst the three that did not find it useful (Participant D, E, and F) were not unanimous as to why. Participant D reported that he did not find it useful because it offered little more than what he already accomplished using a manually maintained list of printouts on his iPad:

*"It's a list of what I've printed, but I can do that by myself. The time taken to make the list doesn't outweigh the time taken to use the tool to find things I've printed. My list was just as effective."*

Participant E found the user interface hard to use, suggesting that he would prefer the structure of the location of the files on his desktop to be preserved for browsing within the prototype:

*"I think it would be better if the tool showed me where the file was located on the computer and let me browse around that way. That's how I remember and think about the files."*

Participant F did not find it useful because she found that it did not update swiftly enough to show the most recently printed documents:

*"I tried to use it early on, but it hadn't caught up with the things I'd just printed, so I didn't get as much use out of it as I might have otherwise."*

Of the nine participants who reported that they found the prototype useful, the reasons why they found it useful were largely consistent. The participants enjoyed the ease of re-accessing the documents that they had most recently printed, tended to search over browse when locating a document on the iPad, and suggested that the prototype had made them more effective and efficient. The following quotes from Participant J represents the group's attitude effectively:

*"It was very useful, I think that I found myself using it without having to remember to after only a day, and it stuck with me. The search was very useful, since I could plug in a few words from whatever printout I was holding in my hand and it would bring up that document almost straight away."*

*"It made me a lot more efficient during meetings since I started to rely on the ability just to bring it right up. If I needed to email someone a copy of something I had on paper I could just call it up and zap it right to them. The way I normally do things is significantly slower."*

Six of the nine participants who found the prototype useful suggested that its interface be made available on the computer in addition to the iPad. Participant B:

*"It would be great to have the app to call up the recent printouts on the computer as well. I have the some problem there, but it happens less often I guess. It would still be very useful on the computer."*

Document File Format	Document Count
PDF (Adobe)	592
DOC and DOCX (Microsoft Word)	201
HTML (Web)	42
Pages (Apple iWork)	7
XLS (Microsoft Excel)	5
PPT (Microsoft Powerpoint)	4
RTF (Rich Text Format)	1

**Table 6.4:** Total documents printed for each file format logged by Prototype 1

The most significant observation from the data related to participants' use of this prototype concerns the specific use-case that most participants employed with it. Participants would utilise the tool to *"quickly rediscover the context of the [printed] document"* by *"searching for a few words from the [printed] document sitting in front of me so the app would tell me what the filename was and when it was printed"*, this information would *"allow me to remember why I printed it, or what it was for"*. Participants' employment of the prototype for this use-case is discussed further in [Chapter 7](#).

As the prototype was logging information on the type of documents printed by participants, information regarding which document file formats were printed was collected. The count of documents printed for each file format is shown in [Table 6.4](#).

This prototype was successful in enabling the usage scenarios described for it in [Section 5.4](#). The scenarios which the prototype addressed were:

- printing documents, attending a meeting, then having to followup using those printed documents after the meeting;
- printing documents and then having to open and make tweaks to the source document files on a tablet during the meeting;
- taking digital notes from a previously printed set of paper documents;

The nine participants who found this prototype useful and effective each reported —without prompting from the researcher, and through both the second diary study and final interview —that the prototype made them more effective than they were previously in meetings, and when trying to note-take based on printouts. They also reported that they were *"satisfied, and had an easier time concentrating on [their meetings]"* due to the prototype helping them *"waste less time"* and *"be less distracted"*. As discussed in [Section 6.3.2.3](#), effectiveness, efficiency, satisfaction, and flow were all key facets useful for evaluating PIM-tools. The nine participants, in this case, all reported that they felt this prototype afforded an improvement for each of these facets.



### 6.4.3 Prototype 2: Emailing Yourself

The second prototype was designed to address the challenges of keeping track of, and successfully making later use of, emails sent to oneself. This section discusses participants' experiences with that prototype.

Across all case study participants there were 373 emails sent from themselves to themselves during the study. This, and a number of other statistics from this prototype, are shown in [Table 6.5](#).

As with printing and Prototype 1, the amount of emails sent to themselves reported by participants prior to participants' use of prototypes was similar to the amount of emails actually sent by participants and logged using the prototypes. All twelve case study participants reported that they found this prototype useful, with ten of them lavishing their descriptions of this prototype with superlatives. Participant G, in an almost identical vein to the other participants, described his experiences with the prototype as follows:

*"This one was extremely, extremely useful. It actually sped up my day, made it quicker to get a lot more done, and made email a much more useful tool for me."*

	Across All Participants
Total Emails Sent to Self	373
Total Attachments (in above emails)	302
Total Searches Performed on iPad	493

**Table 6.5:** Tally of participant use of Prototype 2 during the ten day period

Whilst participants were uniformly positive in reporting their experiences with this prototype, a number of them made suggestions. 8 of the 12 case study participants suggested that the prototype have the ability to delete emails [from the mail server, so that they would disappear from all platforms used to access their email]. The following comment from Participant L illustrates this sentiment:

*"I think it would be better if I could also use the tool on the iPad to delete emails when I was done with them. It would help keep my inbox in order on my computer and my iPhone as well, and I would have to do even less admin on my emails! Maybe it could also preserve the read or unread status of emails when showing them in the iPad tool."*

The majority of emails sent to themselves by participants included attachments. Reinforcing the observations of the pilot and exploratory studies, it is clear that email is being used as a means of ad-hoc document transfer. Participant G:

*"This app means that my email actually behaves more like the file transfer system I frequently treat it as. When I email myself, I'm using it to move files to my iPad, or my home computer."*

This prototype appears to have effectively addressed the usage scenarios that were defined for it in [Section 5.5](#). The scenarios which the prototype addressed were:

- emailing of prepared meeting notes (for personal consumption) to oneself prior to attending the meeting;
- emailing of a collection of documents, as attachments, to oneself, along with a few notes on the content of the documents in the body of the email, to oneself prior to attending a meeting or for future reference;
- emailing oneself some notes as a reminder for an activity that requires attention in the future.

All twelve participants found this prototype useful and effective, and each reported —again, without prompting from the researcher, through both the second diary study and final interview —that they felt that the prototype made them more effective than they were previously at work, and when navigating their emails to themselves. They also reported that they were *"happy with using email to send things to myself"* and *"far less consumed with distracting rage at my own inefficiency [at finding emails sent to oneself]"*. Again, as discussed in [Section 6.3.2.3](#), effectiveness, efficiency, satisfaction, and flow were all key facets useful for evaluating PIM-tools. All twelve participants, in this case, reported that they felt this prototype afforded an improvement for each of these facets.

#### 6.4.4 Prototype 3: Open-documents

The third prototype was designed to address the challenges of maintaining context from the office computer when moving to a tablet device. This section discusses participants' experiences with that prototype.

The open-document context prototype yielded some of the most intriguing and varied responses from participants of the case study. All twelve participants reported that they found the prototype useful, but there was a significantly wider range of different reasons given by participants. Statistics from participants' use of this prototype are shown in [Table 6.6](#).

For example, Participant A found the ability to call up documents that they had been using on their computer useful because it allowed him not to have to email him-



self or print the documents when he left for a meeting with the iPad. This experience was reported by five of the twelve participants:

*"I think it's very useful because I don't need to print as much stuff anymore. I can just pull it all up on the computer before I head over to meetings. It's also caused me to email myself documents quite a bit less, I think."*

Across All Participants	
Daily Mean Open Documents on Computer	11
Total Documents Opened on iPad	182
Total Searches Performed on iPad	416

**Table 6.6:** Tally of participant use of Prototype 3 during the ten day period

Other participants reported adopting a strategy where they would attempt to pre-empt a variety of future information needs, usually prior to attending a meeting, by opening as many documents as they could think of that might be related to their future meeting. As reported by Participant C, the 6 participants who discussed this found it useful to have everything they thought that they might possibly need available in one place, since it was typically stored across a variety of folders and emails on their computer, and was not actually always in one place:

*"It's great to be able to pull up everything I need for the meeting, or things that I might need for the meeting. The material I need for your average meeting is stored in a variety of disparate folders and sometimes even emails on my Mac, so it's refreshing to be able to pull it all up during my meeting prep [in the office] and have it all in one place [in the prototype] during the meeting. To do this I don't even have to change my organisational system for the information, which is working as it is on the Mac."*

This prototype was successful in addressing the usage scenarios that were defined in [Section 5.6.3](#). The scenarios which the prototype addressed were:

- maintaining context with in-use digital documents when moving from a desktop computer to a tablet, often to attend a meeting;
- preparing for a project by grouping related, but otherwise separated documents together in open windows and attempting to re-open that collection on a tablet.

All twelve participants reported that they found this prototype useful, and whilst they reported this for a variety of different reasons eleven of the participants noted that they felt the prototype made them more efficient and effective.



### 6.4.5 Design Recommendations and Feedback

As with the initial evaluation of the prototypes, reported in [Section 5.7](#), the participants of the case study supplied a number of design recommendations. Every participant supplied helpful suggestions regarding each of the three prototypes, regardless of whether they found the prototype useful or not; this echoes past studies that reported similar experiences with their participants (e.g. [Boardman, 2004](#)).

The most prevalent recommendations made by participants for Prototype 1, the printing prototype, were as follows:

- Seven of the twelve participants suggested that this prototype should also log occasions when they utilised the operating system's "Print to PDF" ([Apple, Inc., 2013b](#)) feature, and provide a copy of the resulting PDF. They suggested this would be beneficial as *"in my head, printing to a PDF is basically the same as printing to paper, so I kind of feel like they're the same thing and it's a momentarily jolt of confusion when things I've PDF'd aren't in the list of printed things"*.
- Five of the twelve participants suggested that this prototype should warn if something that the user is attempting to print has already been printed, and allow them to cancel the print operation.

The most common recommendations made by participants for Prototype 2, the email prototype, were as follows:

- Nine of the twelve participants requested the ability to limit their view of recent emails in the iPad application to a specific timeframe, such as *"the last week"*, or *"two weeks ago"*. They all suggested this feature would be useful as they *"tend to remember what notes and docs I need based on the rough dates I created them and emailed them"*.
- Seven of the twelve participants suggested that being able to delete emails they had sent to themselves from the iPad application would be beneficial. They all suggested this feature as *"it would allow me to clean up the app, as it gets bit messy within a few days of use"*. They all qualified their comments along these lines, however, by noting that *"the app was still far more useful than how I managed this before"*.

The most common recommendations made by participants for Prototype 3, the open-document prototype, were as follows:

- Eight out of the twelve participants suggested that the iPad application should provide the ability to browse the open files by displaying the hierarchy used on

the desktop computer. They suggested that this was because *"that's how I think about the files, when I remember them, I think about where I had them on the computer, and often that's all I remember"*.

- Six out of the twelve participants requested the ability to recall the list of documents that was open at a specific point in the past, as they — similar to sentiment expressed about Prototype 2 — reported that they *"think about [their] information in a temporal way, remembering things that were in use at a certain point in time and using that to find what I want"*.

The implications, if any, of such suggestions and requests are discussed further in [Chapter 7](#).

## 6.5 Conclusions

This chapter has partly reported on the case study that was conducted as the third phase of this research. In the case study, twelve participants took part in five stages of investigation: an initial interview, followed by an initial diary study, further interviews and prototype installation, prototype use and a diary study, followed by a final interview.

The case study was designed to collect detailed data over a relatively short period of time from a group of knowledge workers. The data sought revolved around the facets and challenges of PIM and cross-platform PIM identified in the previous phases of the study, as well as the results from the use and evaluation of the software PIM-tool prototypes presented in [Chapter 5](#). The output of the case study can be broken down into the following facets:

- a deeper, focused understanding of the cross-platform PIM practices of a small group of knowledge workers, over a larger period of time;
- observations and participants reports arising from the deployment of three software PIM-tool prototypes, targeting three of the issues reported by participants in past phases;
- further confirmation that the components of *"transferring"* and *"contextualisation"* are valid additions to [Barreau's \(1995\)](#) model, as discussed in [Section 4.5.5](#);

Broadly, the case study has fulfilled the objectives it was designed to, as discussed in [Section 6.2.1](#), by:



1. Building a deeper picture of the use of tablets for PIM, particularly cross-platform PIM, allowing for confirmation of the observations arising from the pilot and exploratory studies.
2. Evaluating and exploring the three software PIM-tool prototypes, deepening knowledge of PIM-tool evaluation techniques, and using the evaluation to confirm the validity of early observations.
3. Gathering the data necessary to further develop and finalise the conceptual model of PIM suggested in [Chapter 4](#), building on [Barreau's \(1995\)](#) model and allowing it to describe cross-platform PIM, at the same time as gathering more data to support the use of the tablet as an exemplar platform for the model.

Similarly, in line with the objectives of the overall research that were discussed in [Section 1.2.1](#), the case study has:

1. increased the body of knowledge relating to PIM, particularly PIM practices amongst knowledge workers, and regarding cross-platform PIM through the lens of tablet computers (addressing Objective 1);
2. confirmed the validity of the necessary additional components in order to effectively present and discuss an empirically-grounded model of cross-platform PIM, using the tablet as an exemplar platform (addressing Objective 2);
3. deployed and evaluated three software PIM-tool prototypes designed, exploring their use and evaluation with participants (addressing Objective 3).

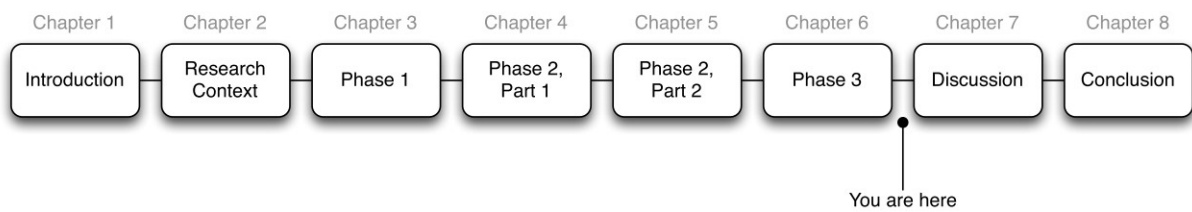
It is argued that the study reported in this chapter was successful in meeting its objectives. The outputs around participants' experiences with the prototypes, use of paper for PIM alongside tablets, and further detail regarding "*transferring*" and "*contextualising*" all further reinforce the research premise and support the objectives. It is clear that cross-platform PIM is not being adequately supported by PIM-tools, but can be, and that it is a particularly challenging facet of PIM in general.

Again, it is important to reiterate that the findings from the study reported on in this chapter are primarily discussed in an integrated form, with the findings from earlier components of the research, in [Chapter 7](#), following.



In the following chapter, the substantive findings from [Chapter 3](#), [Chapter 4](#), and [Chapter 6](#) are integrated and discussed.





*Information. We are overloaded  
and overwhelmed by it and yet we  
can't seem to get enough of it.*

—W. Jones

# 7

## Findings and Discussion

**T**HIS chapter integrates and discusses the findings and observations arising from the pilot study, the exploratory study, the prototype development, and of the case study.

### 7.1 Introduction

In the process of bringing together the various strands of the research, this chapter discusses and evolves the elements presented in previous chapters. As originally stated in [Section 1.2](#), the overarching and initial premise of this research was that *there is insufficient research exploring contemporary cross-platform PIM, as performed by knowledge workers*. Following the review of the research context, reported on in [Chapter 2](#), a number of more specific observations relating to this premise were made.

They were:

- there was a lack of research into the practice of cross-platform PIM;
- there was a lack of research into the use of tablet technology for PIM;
- little is known about the relationships between different PIM-platforms, and the differing ways in which they are used;
- the research-practice gap ([Sutcliffe, 2000](#); [Rogers, 2004](#)), where research outputs can be irrelevant to the real-world needs, is ominously lurking throughout PIM research ([Kljun et al., 2013](#)).

The premise, together with the observations listed above that arose from the review of context, led to the development of three high-level objectives for this research:

1. to develop an understanding of cross-platform PIM, and PIM practices involving modern tablet technology;
2. to propose and evaluate an empirically-grounded model of cross-platform PIM;
3. to propose, implement, and evaluate a number of prototype software PIM-tools that address typical cross-platform PIM challenges.

These objectives were previously described in more detail in [Section 1.2.1](#) and [Section 2.5.1](#). This chapter presents a conceptual model of cross-platform PIM, explores the cross-platform PIM ecosystem, reports on the PIM practices surrounding the use of tablet computers and paper, and discusses the requirements for software PIM-tools designed to support cross-platform PIM. Each of these discussion components are linked back to the overall objectives of the research.

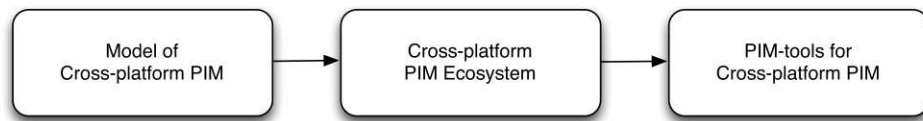
The discussion in this chapter is drawn from the outputs of the pilot study reported on in [Chapter 3](#), the exploratory study reported on in [Chapter 4](#), the prototype development reported on in [Chapter 5](#), and the case study reported on in [Chapter 6](#). Initial components of the output of the case study —how participants used the prototypes —were previously discussed in [Section 6.4](#).

### 7.1.1 Chapter Structure

The discussion is presented across three major sections, with each building upon the last to provide a layered perspective of the findings. A visual overview of the structure of the discussion is shown in [Figure 7.1](#):

- [Section 7.2](#), using the tablet as an exemplar, discusses a model of cross-platform PIM that was developed over the course of the research;
- [Section 7.3](#) discusses the cross-platform PIM ecosystem highlighted by the research, summarising the most prevalent cross-platform PIM behaviours, challenges, and approaches observed and reported by the knowledge workers who participated in the research;
- [Section 7.4](#), again with a cross-platform focus, discusses the evaluation of PIM-tools and common user experience problems with existing PIM-tools reported by participants.





**Figure 7.1:** *Visual overview of the Discussion of Findings*

## 7.2 Understanding Cross-platform PIM

This section suggests a conceptual model for cross-platform PIM, using the outputs from all three studies, as well as data from the development and evaluation of the prototypes. Extending an existing model of PIM to account for cross-platform PIM was first suggested and tentatively explored in [Section 3.6.2](#), as part of the discussion of the findings of the pilot study. A conceptual model was further explored following the discussion of the exploratory study in [Section 4.5.5](#).

This conceptual model, an extension of [Barreau's \(1995\)](#), is now finalised and presented, using the tablet as an exemplar platform, over the following five sections:

- [Section 7.2.1](#) summarises conceptual models general, the use of conceptual models, and the components needed for a conceptual model;
- [Section 7.2.2](#) presents the conceptual model of cross-platform PIM that was developed through the research presented in this thesis;
- [Section 7.2.3](#) presents an initial identification and mapping of a number of variables that characterise and account for a variety of cross-platform PIM behaviour;
- [Section 7.2.4](#) reviews the applicability of the usefulness of the model, and briefly compares and contrasts it with other models of PIM;
- [Section 7.2.5](#) concludes the section by summarising the model and its uses.

### 7.2.1 Conceptual Models

In order to effectively explore a conceptual model it must be understood what a conceptual model is. This section summarises the components and objectives of a conceptual model, and the applicability of a conceptual model to PIM research. Conceptual models were previously discussed as a component of the review of context in [Section 2.3.3](#).

A conceptual model describes something in order to allow for it to be better understood and communicated ([Loucopoulos and Zicari, 1992](#); [Gemino and Wand, 2004](#));

Lazar et al. (2010) suggests that conceptual models are an effective means for codifying and understanding a specific phenomena, area, or domain.

Kung and Soelvberg (1986) describes four fundamental objectives for a well designed conceptual model. They are:

1. to enhance the understanding of the system being represented;
2. to enable efficient communication of system details;
3. to enable those designing for the system;
4. to enable collaboration by allowing for future expansion of the description of the system.

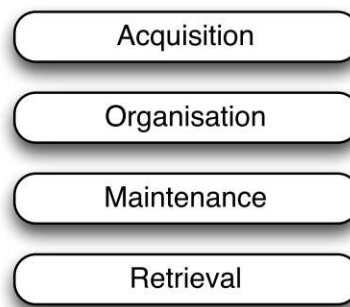
Whilst this definition primarily comes from the domain of formal systems development (e.g. Kung and Soelvberg, 1986; Mayhew, 1999; Choomkasean et al., 2012), it is suitable for understanding the requirements of a conceptual model designed for better understanding an area of research such as PIM (Loucopoulos and Zicari, 1992; Gemino and Wand, 2004). Similarly, past conceptual models developed for PIM research (e.g. Barreau and Nardi, 1995; Ravasio et al., 2004; Boardman, 2004; Jones and Teevan, 2007) — as discussed in Section 2.2.3.1 — meet the objectives proposed by Kung and Soelvberg's (1986) definition.

### 7.2.2 Model for Cross-platform PIM

This section presents the conceptual model developed as a result of this research. As has been noted in earlier discussions, the model presented here is an evolution of Barreau's (1995) work. Barreau's (1995) original model is shown in Figure 7.2, and consists of the sub-activities: *acquisition*, *organisation*, *maintenance*, and *retrieval*.

The extended conceptual model presented in this section is designed to address all four of the objectives for a conceptual model noted in Section 7.2.1. In doing so, it enables future studies and future design projects to both address the challenges of, and to explore, cross-platform PIM (Kung and Soelvberg, 1986). The lens, or exemplar platform, used here is tablet technology. As alluded to earlier in this research, the revised model adds the components *transfer* and *contextualisation*, and is shown in Figure 7.3.

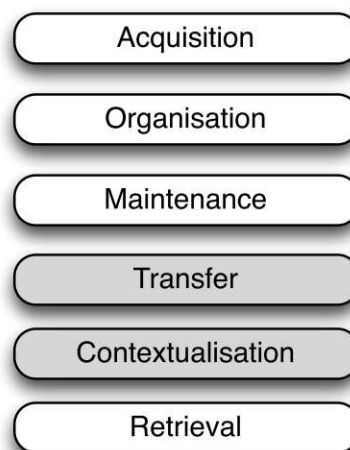
A summary of Barreau's (1995) model is presented here, as it is not necessary to re-cap the sub-activities in excruciating detail; interested readers can return to Section 2.2.3 for an introduction to Barreau's (1995) original work. It is important to reiterate that Barreau's (1995) model was designed for conceptualising PIM being conducted with a single platform, largely with a single PIM-tool — in the case of the origi-



**Figure 7.2:** Original version of *Barreau's (1995) model*

nal research, that platform a personal computer, and the PIM-tool was the filesystem. This extension of the model removes that limitation when describing cross-platform PIM.

In *Barreau's (1995)* original model, *acquisition* relates to the decision behind which information will be kept, and how it will be labelled or grouped. *Organisation* relates to the classification, naming, grouping, and storage of information. *Maintenance* involves the revision of outdated information, the backing up of information, and the moving or removal of information. Finally, *retrieval* relates to the locating of information for reuse.



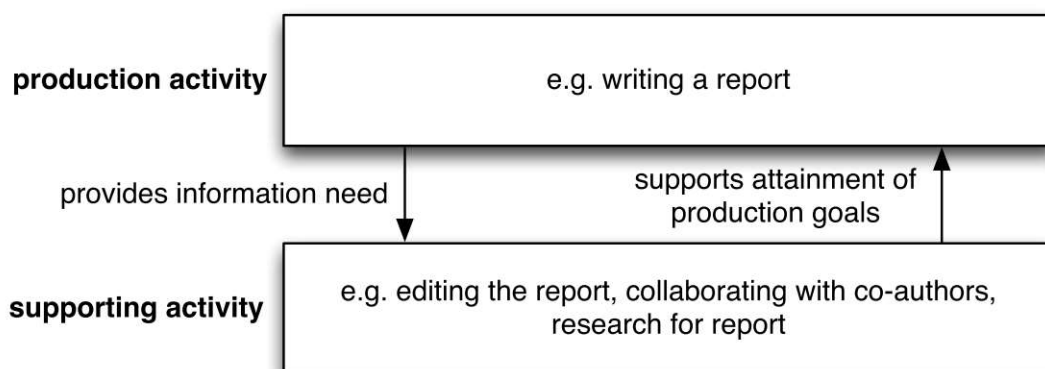
**Figure 7.3:** The revised version of *Barreau's (1995) model*, to be used for exploring cross-platform PIM, highlighting the added components

The two additional components necessary to extend this model, making it suitable for exploring cross-platform PIM, are *transfer* and *contextualisation*. *Transfer* refers to the techniques and challenges involved in moving information items from one



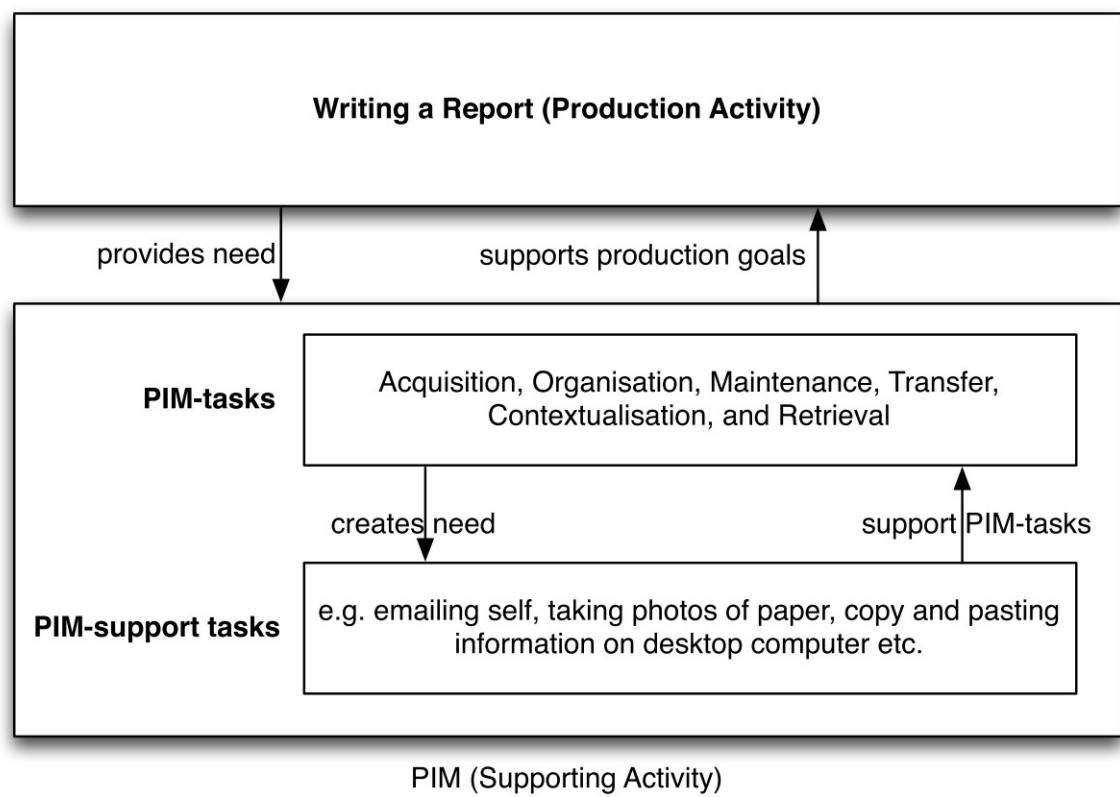
PIM-platform to other PIM-platforms. *Contextualisation* refers to the necessity of regaining one's context within a set of information when switching between different PIM-platforms. Each of these components are discussed in detail in [Section 7.2.2.1](#) and [Section 7.2.2.2](#), respectively.

To achieve a better understanding of how and why [Barreau's \(1995\)](#) model was extended, [Boardman's \(2004\)](#) conception of PIM as a supporting activity is useful. [Boardman \(2004\)](#) suggests that there are two types of work activity: *production activities*, and *supporting activities*. Production activities are the actual work that an individual performs, such as preparing for a specific meeting, or writing a specific report. Supporting activities are the work performed in order to achieve the production activities, such as PIM and everything that it encompasses. An adapted version of [Boardman's \(2004\)](#) diagram illustrating this is shown in [Figure 7.4](#). This conception of PIM was previously discussed in [Section 2.2.3](#). An example of another supporting activity would be the installation of required software to accomplish something.



**Figure 7.4:** A reproduction of [Boardman's \(2004\)](#) diagram, illustrating the supporting activities involved in the production activity of writing a report

The research presented in this thesis suggests that we should be appraising the situation from one level deeper. In addition to being a supporting activity in the context of work, PIM *itself* is made up of "*production activities*" and "*supporting activities*", which may be more correctly referred to in this context as "*PIM-tasks*" and "*PIM-support tasks*". In the context of [Barreau's \(1995\)](#) original model, the core components of the model — acquisition, organisation, maintenance, and retrieval — are PIM-tasks, whilst the mechanisms performed to complete each of those tasks are the PIM-support tasks. In the extended version of the model posited by this thesis, the core components — acquisition, organisation, maintenance, transfer, contextualisation, and retrieval — are PIM-tasks, and again the mechanisms performed to complete each of those tasks are PIM-support tasks. This is illustrated in [Figure 7.5](#).



**Figure 7.5:** *PIM as a supporting activity, in turn made up of PIM tasks and PIM support tasks*

Because of this, the added components of the model arising from this research (*transferring* and *contextualising*) are described in terms of their impact on PIM as a supporting activity, as well as their "supporting activities", or PIM support tasks. In other words, to understand how contextualising and transferring information relate to cross-platform PIM, we must have an understanding of what could be occurring when one is contextualising or transferring information.

Each of the following sections discusses the evidence for each activity derived from the results of the three phases of this research, as well as the characterisations of the different types of transfer and characterisation that were observed. [Section 7.2.2.1](#) discusses the transferring activity and [Section 7.2.2.2](#) discusses the contextualising activity.

#### 7.2.2.1 Transferring Information

This section discusses the first new component added to [Barreau's \(1995\)](#) model of PIM in order for it to support cross-platform PIM: the PIM-task of *transferring*. Transferring refers to the movement of information between different PIM-platforms.

Throughout the three studies, participants reported that one of their primary activities in PIM was the transfer of information between their PIM-platforms. Whilst all participants in the three studies transferred information between platforms, there were a wide range of techniques employed to do this. Participants also described the challenges involved in transferring in a wide range of different ways.

The transfer of information between platforms was described by case study participants as "*painful*", and "*infuriatingly time consuming*"; all participants acknowledged it as something that was necessary to "*get things done*" but suggested that the ways in which it "*had to be done*" were "*less than ideal*".

The outputs of all three phases of this work support the inclusion of information transfer as a key component — a PIM-task — in this model of cross-platform PIM. This section discusses how and why information transfer typically occurs in a cross-platform PIM environment, suggesting that PIM-tools should be built with an understanding of these transfer requirements, and the contexts in which transfers occur, in order to better support real-world cross-platform PIM. The PIM-support tasks that are commonly performed in order to promote the completion of the PIM-task of transferring information are also discussed.

It is important to note that the PIM-support tasks that make up transferring are not an immutable set of tasks; the potential set of PIM-support tasks is boundless and entirely dependent on the activities and requirements of individuals. The PIM-support tasks discussed here are merely one potential set that was observed and reported dur-



ing this research.

This research suggests that transferring is a component of the maintenance activity that was already present in the conceptual model. Maintenance, as defined by Barreau (1995), involves the moving or removal of information, alongside the revision of outdated information, and the backing up of information. Whilst moving can encapsulate the transfer of information between platforms, it does not convey the depth or complexity of the activity that is inherent to cross-platform PIM. Similarly, maintenance is an activity that, according to some PIM studies (e.g. Boardman, 2001; Capra et al., 2013), is performed infrequently. The outputs of the three phases of this research suggest that transfer is an activity that is performed frequently: *"I transfer stuff between platforms constantly, it's a big part of my day."*

Transferring was included in this cross-platform PIM extension of Barreau's (1995) model for a number of reasons, primarily:

- during the pilot study, participants reported transferring with regularity, and identified it as a major point of friction in their ability to efficiently and easily conduct their PIM;
- participants across all studies reported that transferring became more complicated as more PIM-platforms were involved;
- participants across all studies reported using an array of intriguing techniques to *"handle transferring"*, many of which were *"far from ideal, efficient, or easy to deal with"*.

The *transfer* stage of Lin et al. (2004) micronote lifecycle also provided inspiration for this added component.

All twelve participants in the case study conducted cross-platform transfers of information as part of their PIM. Transferring strategies can be classified in a number of different ways. Since transferring in cross-platform PIM had not been discussed in previous work, no classifications of different transfer strategies have been developed. The different transfer strategies case study participants used could be divided into three groups, depending on the intent and activities behind the transfer. The three transfer strategies (Section 7.2.3 discusses other identified cross-platform PIM variables) are identified and shown in Figure 7.6:

1. *planned transfers* are performed in advance of the anticipated requirement of the information being present on a different platform, and with a clear purpose and point in time for the transferred information.

2. *immediate transfers* are performed shortly before the point at which the information being presented on a different platform is required, with a clear purpose and immediate use-case for the transferred information.
3. *converted transfers* are performed in advance of any anticipated requirement of the information being present on a different platform, but do not have a specific requirement or anticipated point in time attached to them — they are performed under the assumption that the information will become necessary or useful on the other platform at some point in the future, but that point is not yet known.

Examples of these different classifications of transfer strategies, taken directly from occasions observed during, or reported by participants of, the case study include:

- *planned transfer*: an individual may use their desktop computer to type a collection of notes for their own consumption, for use at a meeting the following morning; they will then email themselves these notes, so they can read them on their iPad during the meeting, before going home that night.
- *immediate transfer*: an individual may be preparing for a meeting by printing a number of documents which they need to give to a client during the meeting; in order to refer to their own copies of these documents on their iPad during the meeting, they will email themselves all the document files that they printed, and then go and see the client.
- *converted transfer*: an individual may make some scribbled notes on a piece of paper, make use of those notes (from the paper) later in the same day, and then take a photo of the paper using their iPad camera in order to transfer the information to the iPad in case it becomes useful or necessary in the future.

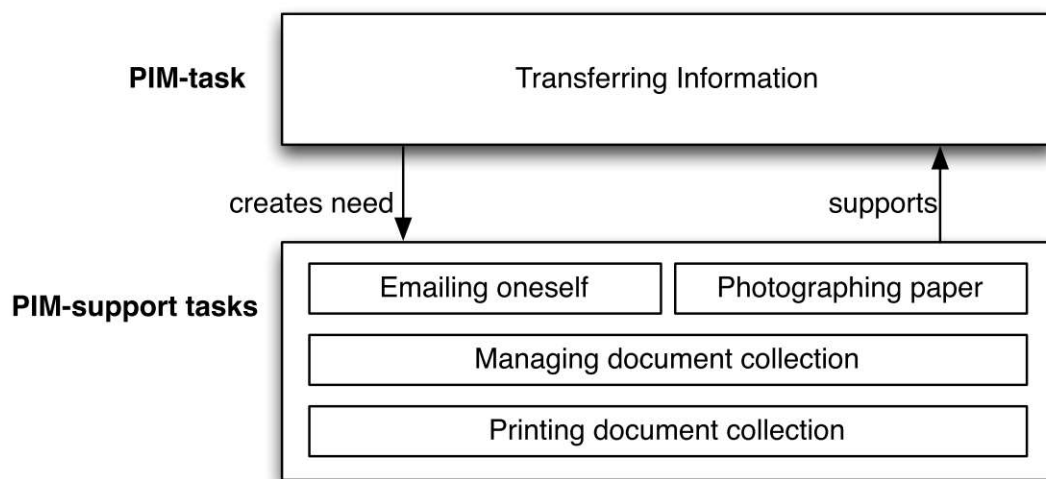


**Figure 7.6:** Classifications of observed cross-platform PIM transfer strategies

As has been suggested throughout the previous sections, transferring has a large number of possible PIM-support tasks. Here we review the most prevalent PIM-support tasks that were observed and reported during the studies of this research, exploring how, when, and why they support the transferring of information. The top three most prevalent PIM-support tasks for transferring, as observed and reported through this research, in order of prevalence, were:

1. emailing oneself information and document files;
2. photographing paper information using a tablet's camera;
3. printing document files from a desktop computer.

These PIM-support tasks are shown in the context of the PIM-task that they support in [Figure 7.7](#).



**Figure 7.7:** The relationship of some example PIM-support tasks to the PIM-task of Transferring Information between platforms

#### 7.2.2.2 Contextualising Information

This section discusses the second and final new component added to [Barreau's \(1995\)](#) model of PIM in order for it to support cross-platform PIM: the PIM-task of *contextualising*. Contextualising refers to the efforts made by an individual in order to reestablish the context and nature of earlier work they were doing, or the information they were working with, when moving between PIM-platforms.

Contextualising was reported by participants throughout the three studies as a significant challenge of moving between different PIM-platforms. All participants



throughout the three studies identified contextualising as a challenge of cross-platform PIM, and many described a wide range of strategies through which they managed this challenge.

Case study participants commented that having to manually work or think to regain the context of the information they were working with when they move between platforms was *"a huge mind drain"*, *"annoying and stressful even at the best of times"*, and *"a complex series of mental manoeuvres"*.

These outputs of all three phases of this work support the inclusion of contextualising as a key component —a PIM-task —of this model of cross-platform PIM. This section discusses how and why contextualisation of information is important in a cross-platform PIM environment, suggesting that PIM-tools should be built with an understanding of these contextualisation requirements in order to better support real-world cross-platform PIM. The PIM-support tasks that are performed to promote the completion of the PIM-task of contextualising are also discussed.

Contextualisation was included in the cross-platform PIM extension of Barreau's (1995) model for a number of reasons. Primarily, these were:

- during the pilot study, participants reported contextualising as a major challenge of working in an environment with a variety of PIM-platforms;
- participants across all studies suggested contextualising became more difficult when more PIM-platforms were involved in their daily PIM workflows;
- participants across all studies reported use of an array of intriguing techniques to *"keep the bloody context of what I was doing in my head"* and unanimously suggested that *"most of the tricks I use to keep context are a f--king nightmare"*.

Contextualising strategies can be classified in a number of different ways. All twelve participants in the case study reported contextualising to be a major consideration of the PIM workflows; through an exploration of their habits, alongside the habits reported by participants in the pilot and exploratory study, three contextualising strategies employed by practitioners of cross-platform PIM were identified.

Since contextualising in cross-platform PIM has not been discussed in previous work, no classifications of different contextualisation strategies have been developed. The contextualisation strategies (Section 7.2.3 discusses other cross-platform PIM variables identified) are shown in Figure 7.8:

1. *immediate contextualising* occurs immediately after an individual has moved between, or transferred information between, different PIM-platforms;

2. *future contextualising* occurs when an individual does not pick up work on a different PIM-platform immediately after transferring information, and attempts to regain context at an arbitrary future point;
3. *ad-hoc contextualising* occurs when an individual picks up work on a different platform at an unexpected arbitrary point in time, and must reacquaint themselves with the context of their information.

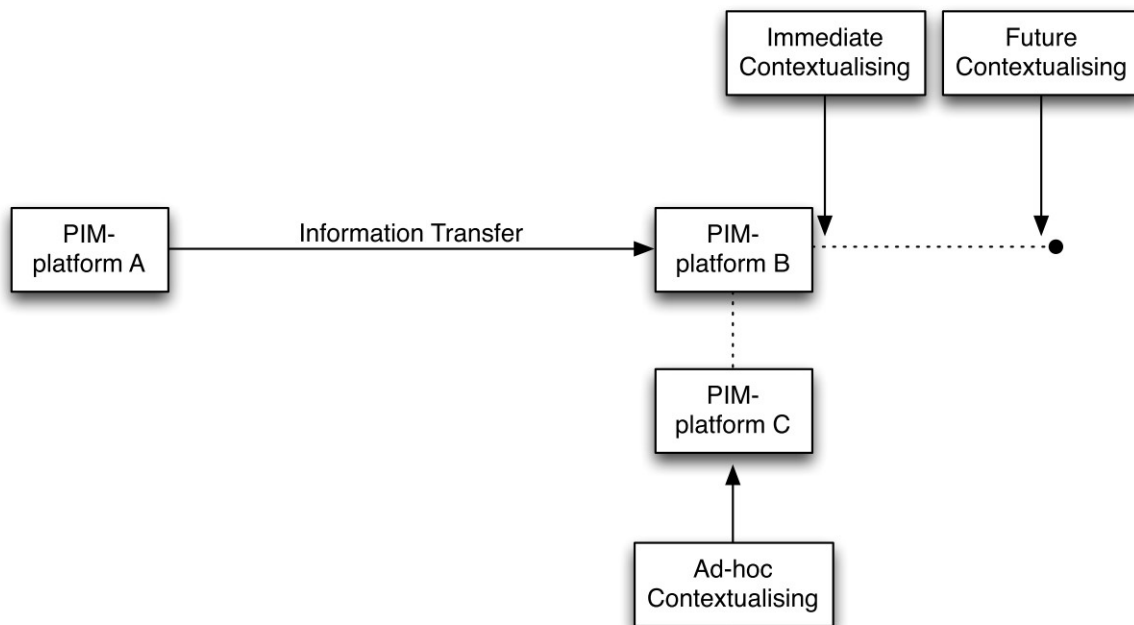
Examples of these different classifications of contextualising strategies, taken directly from occasions observed during, or reported by participants of, the case study include:

- *immediate contextualising*: an individual is working on the office computer and steps out of their office, taking their iPad and a collection of printouts. Moments later, in a meeting, they need to figure out where they were up to in the paper versions of the documents they were previously reading on the screen of their office computer, and use their iPad to locate and open the files that they were reading on the office computer but didn't print.
- *future contextualising*: an individual heads home for the night after reading a collection of digital documents on their office computer, some of which they print and leave in the printer tray; upon returning on a future day, they must determine what they were reading and why.
- *ad-hoc contextualising*: an individual starts work using a previously- or long-unused PIM-platform, such as an office computer or tablet, and must transfer their information to it and reacquaint themselves with the context and content of the information.

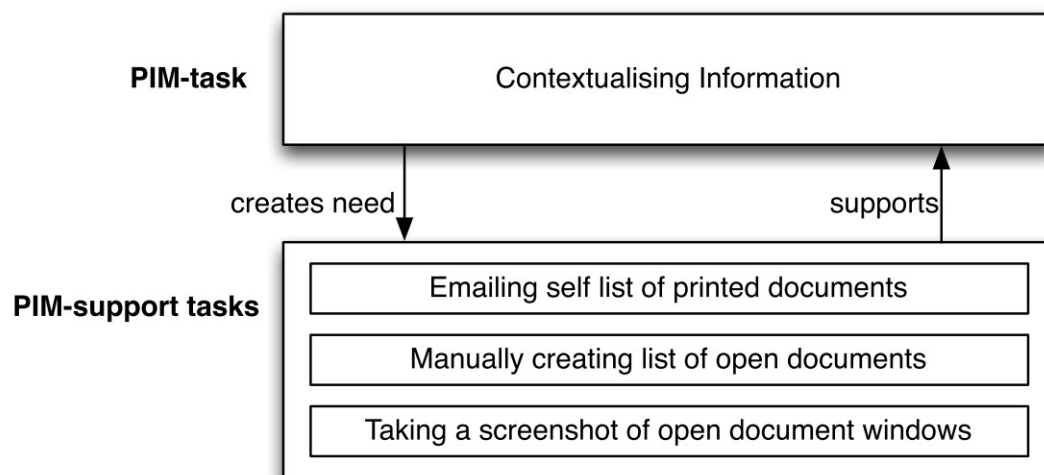
As with transferring, contextualising has a large number of potential PIM-support tasks. Here we review the most prevalent of those reported and observed during the studies of this research, exploring how, when, and why they support the contextualising of information. The most prevalent PIM-support tasks of contextualising were:

- creating a list (in a notes application on a tablet, a computer, a piece of paper, or even via emailing oneself) of recently printed document files;
- creating a list (again, via any one of a number of means) of recently opened and reviewed document files on a desktop computer;
- taking screenshots of open collections of document files to refer to in the future.

These PIM-support tasks are shown in the context of the PIM-task that they support in [Figure 7.9](#).



**Figure 7.8:** *Classifications of observed cross-platform PIM contextualisation strategies*



**Figure 7.9:** *The relationship of PIM-support tasks to the PIM-task of Contextualising Information when moving between platforms*



### 7.2.3 Variables for Cross-platform PIM

This section presents a preliminary report on a number of variables found in the practice of cross-platform PIM. [Bergman's \(2013\)](#) work in identifying variables to account for a variety of digital PIM behaviour — originally discussed in [Chapter 2](#) — is useful to this research; that work, however, lacks the ability to describe cross-platform PIM. [Bergman's \(2013\)](#) variables and categories paint a broad, solid picture of organisation, structure, work process, memory, and retrieval aspects of PIM, but do not adequately cover the facets of cross-platform PIM identified in this research, such as transfer and contextualisation.

As with [Bergman \(2013\)](#), each variable identified is introduced by contrasting the behaviour of participants at each of the extreme poles of its axis, discussed in light of any relevant previous literature, and briefly discussed in the context of potential future studies. Little past research has systematically explored PIM variables ([Bergman, 2013](#)), let alone cross-platform PIM variables.

The spreadsheet-based documents that were developed from the data of each case study participant, as noted in [Section 6.3.9](#), as well as the resulting codes from the grounded theory-based approach used in the analysis presented in [Section 6.3.9.2](#), were repeatedly compared to find variables in which participants behaved differently for cross-platform PIM. This was done using the same technique as [Bergman \(2013\)](#) — however, [Bergman's \(2013\)](#) publication emerged following this work being completed, so it was not directly based on or inspired by it. The final codes, as well as the core concepts arising from them, identified from the thematic analyses and GTM-based analysis conducted in the pilot and exploratory studies, also played a part.

For each variable identified, the extreme points of the variable's axis were looked at; if a variable appeared to have more discrete categories, participants who would have different values were explored. Six variables were found, which were grouped into two classification categories, mirroring the additional components of cross-platform PIM identified for inclusion in the model earlier in [Section 7.2.2](#): *transfer* and *contextualisation*.

	Variable	Axis
Transferring	strategy	Immediate, planned, converted
	frequency	Rare  -----  Constant
	complexity	Simple  -----  Complex
Contextualising	strategy	Immediate, future, ad-hoc
	complexity	Simple  -----  Complex
	duration	Short  -----  Long

**Table 7.1:** Categories, names, and axes of variables

The dominant variable in each category, *strategy*, was previously discussed earlier in this section. [Section 7.2.3.1](#) and [Section 7.2.3.2](#), following, further discuss the other variables identified. All examples given come from participants of the case study.

### 7.2.3.1 Transfer related variables

Of the three variables identified for transfer, the most dominant found in participants was *strategy*; the other transfer variables identified were *frequency* and *complexity*.

*Strategy*, in the context of transferring, was discussed at length by all case study participants. The three main ways in which participants think about transfer strategy are immediate, planned, and converted transfers. These were previously discussed in [Section 7.2.2.1](#).

*Frequency* was also discussed by all participants in the case study. The axis for frequency ranges from rare to constant. An example of rare transfer frequency can be seen with a participant who only very occasionally moved information between their PIM-platforms compared to other participants, preferring to do so only when they felt it was absolutely necessary. They suggested that this meant they often found themselves in situations where they had not transferred information that they ended up requiring, causing stressful and ineffective situations: *"because I try to move so little, I kind of end up without things I really do need!"* Another participant, who near-constantly transferred information between her various PIM-platforms, illustrates constant transfer frequency; she often found herself in a situation where she had transferred so much from one PIM-platform to another, for example via email from her desktop for use on her iPad, that she had trouble sorting through what was actually needed. She suggested that she performed such constant transfers as a way of *"making sure any information I might need is available always"*.

*Complexity* describes the complexity of the transfer PIM-support tasks performed by an individual. The axis for complexity ranges from simple to complex. Simple is showcased by a participant who —for example —regularly used email to transfer a number of document files from her office computer to her iPad. Complex is showcased by a participant who —for example —used their iPad's camera to capture images of *"scrappy paper notes"* and then regularly spent *"twenty or thirty minutes, if not more, cleaning up the images before I email them to myself so I can use them on the computer"*.

### 7.2.3.2 Contextualisation related variables

Of the three variables identified for contextualisation, the most dominant found in participants was again *strategy*; the other variables identified were *complexity* and *duration*.



*Strategy*, in the context of contextualising, was discussed at length by all case study participants. The three main ways in which participants think about contextualisation strategies are immediate, future, and ad-hoc. These were previously discussed in [Section 7.2.2.2](#).

*Complexity* was also discussed by all participants in the case study. The axis for difficulty ranges from simple to complex. An example of complex can be seen with a participant who reported creating multiple lists for documents he had recently printed, had open on his desktop computer, or needed to refer to, and often *"take[s] screenshots of things I have open on my computer, email[s] them to myself, and then slowly find and open all those documents on my iPad or in a stack of paper"*. Simple is illustrated by another participant who relied on their memory to remember what they were using on the previous platform when they switched to the next, but commented *"that I often forget what was going on, and have to spend more time than I should getting up to speed"*.

*Duration* describes how long it takes an individual to regain their context when moving between platforms. The axis for duration ranges from short to long. Long durations are showcased by a participant who reported taking upwards of ten minutes to reacquaint themselves with their information and work context when moving between platforms. Short durations are showcased by a participant who managed to *"get up and running"* within a moment or two, thanks to *"a few quick lists and a good memory"*.

#### 7.2.4 Using the Model

This section concludes the presentation of the model of cross-platform PIM by reviewing the applicability and potential usefulness of the model, and briefly contrasting it with other models of PIM. Whilst [Section 7.2.1](#) and [Section 2.3.3](#) made a number of general observations regarding the utility and application of contextual models, it is useful to explore the specific reasons for the usefulness of this model, and the ways in which it might be applied to future research or product design.

One of the primary uses for a conceptual model in a domain such as cross-platform PIM is the design of systems and tools for the domain ([Loucopoulos and Zicari, 1992](#); [Gemino and Wand, 2004](#)). The model, through its description of the domain, the concepts present in the domain, and the relationships between the concepts allows designers and researchers to map between the concepts and necessary user experience or capabilities ([Loucopoulos and Zicari, 1992](#); [Gemino and Wand, 2004](#)).

As was discussed in [Chapter 2](#), [Rogers \(2004\)](#) suggests that theory in similar research — such as models — should describe and explain interactive phenomena, make predictions on the effect and impact of a design, and generate new routes for design.



This model fulfils all of these requirements to some extent, but particularly serves to describe and explain cross-platform PIM activities, and provide guidance on future design.

The model presented in this research has ties to a number of past models and frameworks of PIM. Specifically, the following models are worth touching on:

- [Barreau's \(1995\)](#) monolithic model of PIM, centred around a file system, that serves as the basis for the evolved model presented in this chapter;
- [Boardman's \(2004\)](#) extension of the above model, centred around a computer with a collection of PIM-tools running on it;
- [Jones's \(2012\)](#) general model of PIM, showing people's needs in correlation to information.

These three models were previously discussed in [Section 2.2.3](#), and interested readers should return there for a description of each; this section briefly contrasts them to the extended model of cross-platform PIM proposed by this work.

[Barreau's \(1995\)](#) model is unsuitable for exploring and describing the real-world activities of cross-platform PIM, as it omits both any semblance of transferring or contextualising from the model. [Boardman's \(2004\)](#) is only a minor improvement in this respect, as whilst it does acknowledge the role of "*integration mechanisms*" between PIM-tools, it does not acknowledge any form of transfer between PIM-platforms.

[Jones's \(2012\)](#) framework, which is not directly based on the work of [Barreau \(1995\)](#), is more general and seeks to describe an entire information space. While it could be seen to be compatible with, and indeed partially represent cross-platform PIM, it does not specifically describe the facets of cross-platform PIM: they can be inferred from what it does describe, but this is less than ideal.

The extended model of cross-platform PIM proposed by this work can serve future work in a variety of ways, namely (but not limited to):

- raising awareness of two PIM-activities that are strongly related to the specific challenges of cross-platform PIM —*transferring* and *contextualising*—by making them core components of the model, rather than implied components, as with [Jones's \(2012\)](#) model, or excluded components, as with most other models;
- describing the various classifications of transfer and contextualisation strategy, and allowing future research and tool design to better serve the needs of individuals conducting cross-platform PIM;

- providing an empirically grounded basis upon which future platforms can be explored, in the same manner the tablet was used as a lens for the present research.

The general objectives and requirements of a conceptual model were previously discussed in [Section 7.2.1](#) and [Section 7.2.1](#). The conceptual model proposed by this work, based on the work of [Barreau \(1995\)](#), addresses all four fundamental objectives of conceptual models ([Kung and Soelvsberg, 1986](#); [Loucopoulos and Zicari, 1992](#); [Gemino and Wand, 2004](#)).

The variables to describe cross-platform PIM that were presented in [Section 7.2.3](#) can be used in a variety of ways to support future PIM research. Particularly valuable would be a systematic exploration of how these variables are affected by external, previously identified things such as personality traits, cognitive abilities —such as memory, and work demands. [Bergman \(2013\)](#), for example, suggests that PIM variables could be used to systematically explore how work demand has an impact on PIM behaviour. [Malone \(1983\)](#) reported that individuals who have routine jobs typically have more neat desks than those whose jobs are not routine. Human cognitive ability and personality traits could also be explored, although measuring external variables would require lengthy psychological tests ([Bergman, 2013](#)).

Exploring the variables in the future, and understanding the relationships between these variables —and others —will allow deeper questions, and reasons for certain connections and activities to arise and allow for new theories and models to be developed ([Jones, 2012](#); [Bergman, 2013](#)). Such theories and models will be able to be used, eventually, for predictive theory ([Rogers, 2004](#)) that can be tested ([Bergman, 2013](#)); an example of this "*evidence-based comprehensive theoretical explanation*" can be seen in [Whittaker et al. \(2011\)](#). Such explorations may begin to address the research-practice gap ([Sutcliffe, 2000](#); [Rogers, 2004](#)) in the PIM-domain ([Kljun et al., 2013](#)).

### 7.2.5 Summary

In summary, the model of cross-platform PIM that has been developed —based on [Barreau's \(1995\)](#) work —has myriad possible uses for future PIM research. The model's additional components —*transfer* and *contextualisation* —together with an understanding of the strategies and other variables present in cross-platform PIM provides an empirical base for future research projects to built upon, and for future PIM-tool products to base their design and assessments of worth. By measuring the distribution of these variables, finding the relationship between them, testing the effect of external variables such as systems design, and finding how they affect dependent variables



such as productivity, future research will be able to further improve our understanding of cross-platform PIM.

This section has addressed the objectives of the work, as originally reported in [Section 1.2.1](#), by further developing our understanding of cross-platform PIM, and practices involving tablet technology, by extending a popular theoretical model of PIM to be applicable for cross-platform PIM and discussing that model through the lens of tablet technology. The next section continues this by exploring the PIM ecosystem, and the role of tablet technology, that was highlighted by this research.

## 7.3 The PIM Ecosystem

The previous section summarised and discussed the conceptual model of cross-platform PIM that was developed from [Barreau's \(1995\)](#) work. This section draws on that extended conceptual model, and further discusses the typical PIM ecosystem in which study participants from all three phases worked. It explores the most common techniques employed by study participants to stay productive in the challenging cross-platform PIM environment, the typical environments participants performed their PIM in, and the role of tablet technology in PIM.

The data from all phases of the research was combined to build this picture of contemporary, cross-platform PIM, discussed over the following sections:

- [Section 7.3.1](#) briefly highlights the nature of past PIM ecosystems, drawing on both past research and participant observations;
- [Section 7.3.2](#) explores the nature of contemporary PIM ecosystems and presents a number of personas based on study participants;
- [Section 7.3.3](#) describes and explores the role of paper as it was observed and reported in relation to cross-platform PIM;
- [Section 7.3.4](#) concludes the section with a summary of the contemporary cross-platform PIM ecosystem.

### 7.3.1 Past PIM Ecosystems

This exploration of the contemporary cross-platform PIM ecosystem revealed by this research begins by taking a step back and reiterating the state of PIM ecosystems as they were, or were thought to be, in the past. This section draws upon past literature as well as anecdotal commentary provided by participants in the three phases of this research, to briefly highlight the nature of PIM ecosystems as they are represented by



past research. Interested readers should return to [Chapter 2](#), where similar material was presented.

Despite the optimism of [Bush's \(1945\) "Memex"](#) —originally discussed in [Section 2.1](#)—and the paperless office ([Sellen and Harper, 2003](#)), the recent history of PIM involves a lot of paper ([Buttfield-Addison et al., 2009](#)), a lot of relatively unstructured piles of documents, and a vast range of organisational, maintenance, and storage strategies for personal information ([Jones, 2012](#)). The facets of past PIM ecosystems and past PIM research that are important to highlight here are as follows:

- the paperless office has not eventuated, and is unlikely to eventuate for the foreseeable future ([Sellen and Harper, 2003](#)); people still use paper extensively ([Farrell and Lute, 2013](#); [Goldman, 2013](#)), and PIM-tools need to acknowledge this ([Buttfield-Addison et al., 2009, 2012](#));
- at the dawn of PIM research, cross-platform PIM was not perceived to be as common as it is now; PIM research used to focus on PIM in the context of the workings of a single platform (most commonly the personal computer), which is where models such as [Barreau's \(1995\)](#) come from;
- eventually, PIM research came to occasionally focus on PIM-tools, and the interrelation between those tools (e.g., [Boardman, 2004](#); [Reimer et al., 2006](#); [Kljun and Dix, 2010](#)), but individuals using multiple PIM-platforms have become even more prevalent, and research has not caught up;
- realistically, cross-platform PIM has likely always been commonplace —it just took every individual having a desktop computer, a smartphone, a laptop computer, a tablet computer ([Jones, 2012](#)), and *still* using paper ([Buttfield-Addison et al., 2009](#)), for anyone to notice.

Ironically, PIM has likely always been a highly cross-platform activity —this can be seen from the literature of bygone PIM research, even when PIM was predominantly a paper-based activity it took place across multiple platforms: filing cabinets, books, binders, and so on (e.g. [Malone, 1983](#)). Despite this, past literature often appears to disregard that PIM is a cross-platform activity, even when it discusses PIM in a cross-tool context, where a number of the tools are spread across multiple platforms (e.g. [Boardman, 2001!](#))

In summary, PIM was treated in the past by researchers as involving far fewer platforms than they actually had, leading to a glut of research focusing on the inner workings of individual platforms, but very little research exploring how these platforms interrelate. This research seeks to ease this imbalance. The following section discusses the contemporary PIM ecosystem that emerged through this research.

### 7.3.2 Contemporary PIM Ecosystems

The studies conducted across the three phases of the research have highlighted the complex, cross-platform, cross-tool nature of the contemporary PIM ecosystem. Here, the makeup of this ecosystem is further presented, and the peculiarities of working in a cross-platform PIM environment are highlighted. This is done primarily by using two pieces of content:

1. a review of the typical make-up of the office environment encountered amongst participants of all three phases;
2. a set of user personas ([Pruitt and Grudin, 2003](#)), designed to showcase participants with similar situations.

The review of the typical make-up of the office environment showcases how and where cross-platform PIM is conducted, the platforms it is typically conducted between, and the way each platform is uniquely used. Participant data from all three phases of the research is used.

Personas and archetypes were first discussed in [Section 2.3.3](#). The archetypal characters each represent a group of participants who share common, or similar, goals, attitudes, and behaviours in their cross-platform PIM ecosystem ([Putnam et al., 2012](#)). Highly specific archetypes are extremely useful for future design ([Cooper, Alan and Reimann, Robert and Cronin, David, 2012](#); [Moser et al., 2012](#)). The personas presented here are gestalt entities, representative of the behaviour and attitudes of a range of participants throughout all three phases of the research ([Cooper, Alan, 1999](#); [Cooper, Alan and Reimann, Robert and Cronin, David, 2012](#)).

The specific facets of [Cooper, Alan's \(1999\)](#) work that are used in the development of the personas are:

- they are grounded in the data;
- they express motivations and goals;
- they encapsulate a specific set of usage patterns and needs;
- they are represented as specific individuals that each represent a class of people, not a particular real person.

Personas for the most prevalent behaviours, attitudes, and techniques for each of the facets of cross-platform PIM were developed. While these personas do not encapsulate every single facet of cross-platform PIM, they do present a rich picture



of the approaches to PIM observed, and allow for future focused discussion around each of them rather than a muddled attempt at all-encompassing discussion.

Personas are an exceptionally strong tool for discussing results, designing tools, and representing qualitative results (Pruitt and Grudin, 2003). As noted by Schroeter (2012), it is important to point out that personas are not mutually exclusive, and one real-world individual could take on multiple archetypal roles.

In product design, the development of personas can help the design process by substituting fairly abstract, elastic, or contradictory needs with a variety of vibrant, specific personas (Sinha, 2003). Likewise, Pruitt and Grudin (2003) observes that whilst personas are, first and foremost, intended to aid design, they complement and amplify the effectiveness of qualitative (and quantitative) methodologies (Lazar et al., 2010).

Preceded by an overview of the typical office environment encountered throughout the three phases of the study, each of the personas is presented in turn, first with an initial character sketch followed by the core themes of the personas. These personas encapsulate the core concepts —discussed in Section 7.2: *transferring* information and *contextualising* information, as well as organising information, and the use of micronotes and paper —that arose from consideration of the output of the pilot study, exploratory study, and case study collectively:

- Section 7.3.2.1 describes the typical PIM ecosystem encountered throughout the three phases of the study;
- Section 7.3.2.2 presents the persona of "William", showcasing a user who prepares for a lot of meetings, uses a lot of printed documents, and uses his iPad camera for input frequently.
- Section 7.3.2.3 presents the persona of "Beverley", which focuses on a user who frequently emails themselves, takes photos of information scraps on paper, and struggles maintaining context between platforms;
- Section 7.3.2.4 presents the persona of "Wesley", showcasing the intriguing relationship between tablet computers and the use of paper for micronotes;
- Section 7.3.2.5 discusses the relevance of the personas presented and the typical contemporary PIM environment.

#### 7.3.2.1 Typical Environment

As was suggested early on in this thesis, through the initial results of the pilot study reported in Section 3.4, and the results of the exploratory study reported in Section 4.5.1.3, the most prevalent PIM-platforms encountered at all phases of the research were:

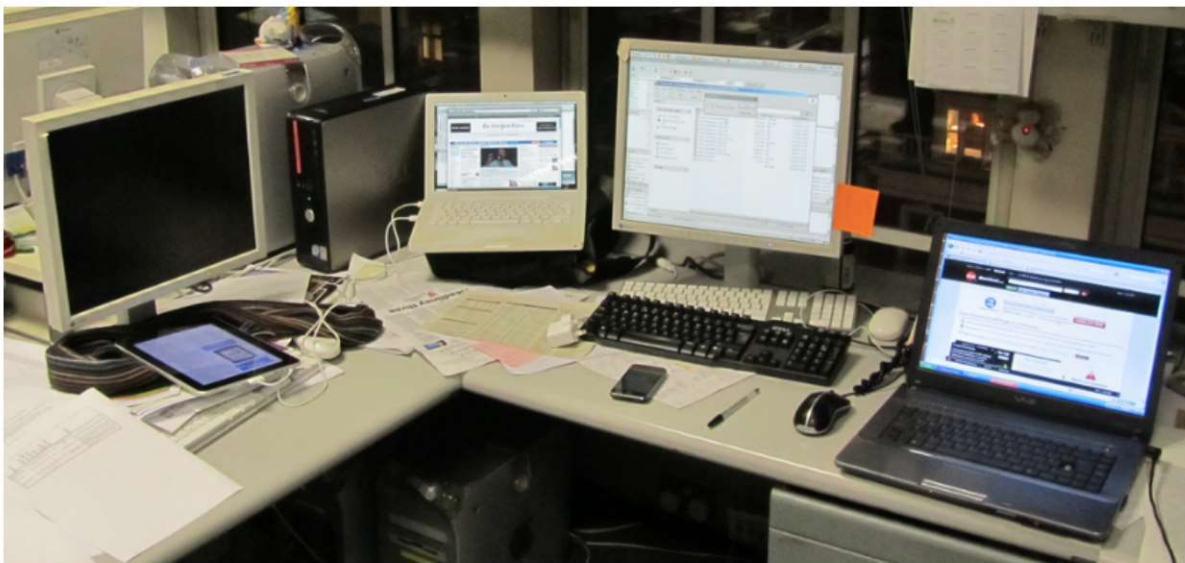


- tablet computer;
- office computer;
- paper documents.

Alongside this, and again as suggested through the initial results of the pilot study, the most prevalent PIM-tools encountered at all phases of the research were:

- email;
- document files.

All participants encountered in the exploratory study and in the case study made regular use of a tablet computer, an office computer, and paper documents; they all attempted to move fluidly between these PIM-platforms on a consistent, if not regular, basis, and they all struggled to transfer information between them and regain their context when they did. An example of a typical office encountered amongst participants in all phases of the research is shown in [Figure 7.10](#).



**Figure 7.10:** *An example of a present-day office/desk with a myriad platforms and tools*

Whilst all users in the exploratory study and case study used a tablet computer —something that can be seen as representative of a general industry trend away from stationary technology towards mobility ([Tungare and Pérez-Quinones, 2008](#)) —the outputs of these studies also suggest that tablet users may be cleanly divided into two distinct categories of user:

- *heavy users*, who either use or attempt to use their tablet in almost all of their everyday PIM-related tasks;

- *occasional users*, who typically use their tablet on a daily basis, but do not incorporate it, or attempt to incorporate it, into every facet of their PIM.

*Heavy users* are exemplified by the following quote, from a participant in the exploratory study:

*"I use the iPad for everything – if I have to annotate a document, I use the iPad, if I have to print a document, I print from the iPad, if I have a document I've written on with a pen, I take a photo with the iPad. Everything goes into or out of the iPad."*

*Occasional users* are exemplified by the following quote, also from a participant in the exploratory study:

*"I do my email on the iPad and make meeting notes on the iPad, but I don't go out of my way to get my documents into the iPad. It's always with me but my life is fragmented between it, my paper stuff, my laptop and my desktop computers."*

In developing these categories, [Barreau's \(1995\)](#) model of PIM, and the extension of it to support cross-platform PIM that was presented in [Section 7.2](#), were used to explore how behaviours differed. For example, participant experiences across all three phases of this research suggest that certain activities were transplanted from other devices upon acquisition of a tablet; a typical example of this behaviour is shown in the following quote from an exploratory study participant:

*"I used to carry my [smart]phone to meetings so I could email myself notes, but now I don't – I don't receive calls during the day on that phone so I don't need to carry it around. I have the iPad and make my notes on that."*

This echoes and extends the findings of past research, such as [Tungare and Pérez-Quinones \(2008\)](#), where it was reported that certain PIM activities were moved from one device to another upon the acquisition of a multi-purpose device. Study participants across all three phases reported that, due to their tablet, they found themselves using their office computers significantly less — regardless of whether their office computer was a laptop or desktop machine. Participants reported working on projects with both paper documents and the tablet, where before they noted they would have instead used their office computer:

*"I make less notes on paper since I got the iPad, so I often carry a printout of something I need to annotate and make the notes on the iPad while I read the paper."*

Study participants appear to find the tablet to have a complementary role to paper; one participant from the exploratory study reported:



*"I used to make notes about documents in Evernote on my Mac [his office computer] while I read a PDF document alongside it on the screen, but now I print the document and make notes on my iPad without using the Mac at all for it."*

Intriguingly, all heavy users noted that they *"used to use a lot less paper before I got the iPad"*, with many commenting that *"my regular computer usage has gone way down, but I use paper a lot more often, but I use it with the iPad now"*. When asked to elaborate, most heavy users observed that they *"used to use paper for writing scrappy notes, but use the iPad for that now"*; all heavy users further noted that they *"print more paper so I can make notes about the contents [on the iPad] without being tethered to my computer."* The suggestion that heavy use of the tablet may actually increase the use of paper for certain tasks is intriguing, and is further discussed in [Section 7.3.3](#).

All heavy and occasional users expressed concern that they *"might not have everything needed on the iPad"* when discussing how they often only took the tablet with them when leaving the office. *"There's no way I'm going to take anything else with me, that'd just be annoying, but I get worried I have not copied something to my iPad or that it's not in my notes on there"* remarked one participant who was categorised as a heavy user. An initial version of these heavy and occasional user categorisations was presented in [Buttfield-Addison et al. \(2012\)](#).

Cross-platform transfer and contextualisation were identified as particularly unique facets of cross-platform PIM during all three phases of the research, and the challenges and strategies faced and employed by participants were highly prevalent throughout the research. The most prevalent transfer strategies — or PIM-support tasks of the PIM-task of transferring, as discussed in [Section 7.2.2](#) — employed by case study participants to move information between PIM-platforms were:

- emailing oneself notes or document files;
- photographing paper notes, using a tablet computer's camera;
- printing document files from a desktop computer.

The most prevalent contextualisation strategies — or PIM-support tasks of the PIM-task of contextualising, as discussed in [Section 7.2.2](#) — employed by participants to regain context when moving between PIM-platforms were:

- maintaining a manually-created list of printed document files, so printed paper could be matched up with digital documents;
- maintaining a manually-created list of recently-reviewed (via their desktop computer, or tablet computer) document files, so the files could be located on a different platform at a later date;



- taking screenshots of open collections of document files to refer to in the future.

Additionally, a number of unanticipated facets with regards to participants' use of paper alongside the tablet and other platforms were observed and reported in all three phases of this research. Namely, that the use of tablets appears to increase the use of paper for one reason, and decrease it for others. This intriguing observation is further discussed in [Section 7.3.3](#).

**Role of the Tablet** The focal platform of this study — the tablet — appears to take on a variety of roles in cross-platform PIM, primarily:

- as a way to capture information from other platforms, such as making notes regarding paper-based information or printed documents;
- as a temporary holding space or transport mechanism for document files that have been emailed, or photos of paper documents;
- as a platform for reviewing, reading, and otherwise consuming information that has been created elsewhere and transferred to the tablet.

**Role of the Office Computer** The office computer, another of the most prevalent platforms used for PIM, also takes on a variety of roles in cross-platform PIM, primarily:

- somewhat obviously, as a central repository/storage location for a hierarchical collection of document files;
- also somewhat obviously, as a creation point for printed document files;
- as an input device, leading to the creation of emails sent to oneself, for later consumption on other platforms.

**Role of Paper** The roles of paper, the third platform of interest to this research, were many and varied. To that end, an entire section of this chapter is dedicated to it: [Section 7.3.3](#) explores the unique role of paper, alongside the tablet and other platforms.

The following three sections present the personas that were developed to showcase the contemporary cross-platform PIM ecosystem reported by participants in all three phases of this research. Personas such as these can be used for future PIM-tool development, as they effectively convey a set of goals and tasks which can be used to both create and then evaluate and explore future PIM-tools, especially in concert with scenarios ([Kelly and Teevan, 2007](#)).

### 7.3.2.2 Persona: William

William<sup>1</sup> works in his own private office, and makes use of a personal computer equipped with its own printer and an iPad tablet computer. Because more than half of his working days are typically occupied with meetings he has to spend a lot of time preparing and understanding the material covered in them; this preparing usually involves printing a large number of document files.

Prior to a typical meeting, William usually skims the contents of the documents for that meeting by opening them all on his personal computer and quickly scrolling through them. Once he feels that he has a summary understanding of the material, he will print a copy of each document using the printer located in his office and, after stapling each document together, place the collection in a small pile. The pile typically contains between 5 and 20 documents.

William will then, using the email client installed on his personal computer, send an email to himself containing the document files of all the documents that he has printed. He does this in order to provide himself with quick access to the document files via his iPad for when he is in the meeting. Sometimes William will include some notes to remind himself of the most pertinent pieces of information in the body of his email.

At the meeting, William spends time identifying which paper document is related to which file (from the files attached to the email he sent to himself, which he now has open on his iPad). He does this by briefly opening each document file using the email client on his iPad and visually comparing the first page to the first page of each paper document; once he has identified each document, he often writes the file name at the top of the page using a pen.

As the meeting progresses, William will use the search feature of the iPad to search the contents of the documents that he emailed to himself in order to find relevant pieces of content within specific files; once he has identified on which page the content is, he will flip the paper document to the relevant location. He also annotates the paper documents with his pen, typically writing a few sentences in the margin every few pages.

As the meeting begins to conclude, or back in his office afterwards, William frequently uses the camera feature of his iPad to take photos of some of the notes he has made in the margins of the paper documents, emailing himself the photos from the iPad (so that he can access them later on his personal computer) before discarding the paper document entirely.

At future meetings, or generally when William needs to refer to the notes from the

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<sup>1</sup>Readers should imagine William has a magnificent beard.



margins that he captured using photos, he will attempt to search his email (either on his iPad or the personal computer) by the date that his calendar suggests the meeting he remembers making the notes during took place. Often he will be unable to locate these notes in a reasonable timeframe.

**Summary of William** William represents an individual who:

- has lots of meetings on a weekly basis;
- uses lots of printed paper documents;
- has trouble remembering why certain documents were printed;
- uses search to find documents on their iPad, and in their email;
- uses their iPad's camera to capture and transfer information from paper to the iPad.

#### 7.3.2.3 Persona: Beverley

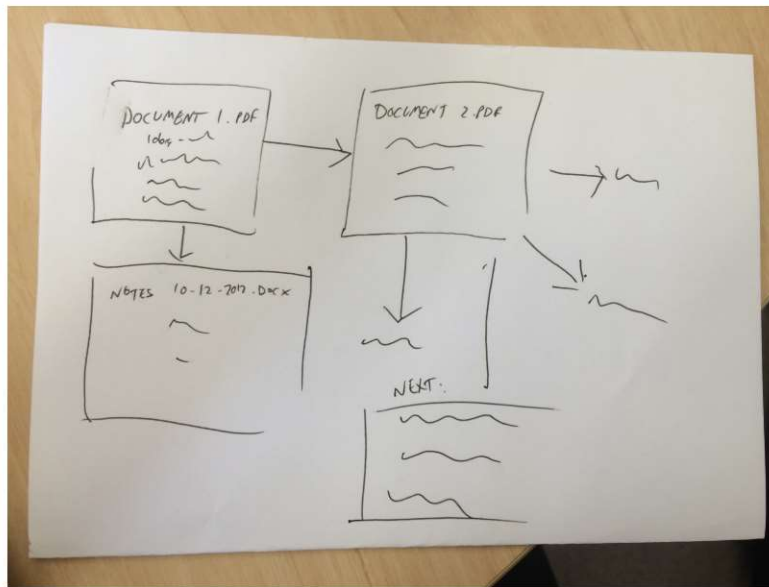
Beverley works in her own private office, making use of a personal computer equipped with a printer, and an iPad tablet computer. Beverley spends one day a week in a full-day meeting, and spends the majority of the rest of the week preparing for that meeting. Because of this, the majority of her time is consumed with the review and consumption of a wide variety of information, and the creation of new information. Beverley works with a large amount of document files and paper documents, and regularly prints documents using her printer.

Early in the week, Beverley spends a day planning the structure of the meeting; she does this by opening a wide range of document files on her personal computer at the beginning of the day and slowly browsing through them over the remainder of the day, making notes about the content of them in a paper notebook. The following day she reviews these paper-based notes, further summarising them into a page or two of flow-chart style diagrams — an example of this is shown in [Figure 7.11](#).

After completing her flow-chart style diagram of the requirements for her meeting, Beverley usually takes a photo of the paper using the camera on her iPad and stores it in the iOS photo library. The original piece of paper is typically then discarded.

Beverley uses email as the default way to transfer information from her computer to her iPad; often, after printing a number of documents, Beverley will email herself the document files so that she can keep track of what document she has printed.





**Figure 7.11:** An example of the paper-based flow-chart style diagrams drawn by Beverley (recreation, omitting actual information)

**Summary of Beverley** Beverley represents an individual who:

- emails themselves information frequently;
- takes many photos of micronotes;
- has trouble remembering and using the context of documents left open on their computer;

#### 7.3.2.4 Persona: Wesley

Wesley works in his own private office, making use of a personal computer and an iPad tablet computer. Wesley has between one and three meetings, each lasting under an hour, each day of the working week. Wesley is typically not a central or dominant figure in these meetings, but requires a few pieces of information that are verbally shared at these meetings in order to do his job.

During the meeting, Wesley makes a series of small notes on his iPad, often using software like Apple's Notes application to record them. During parts of the meeting that involve reviewing documents, Wesley often opens up the digital files for these documents on his iPad via emails he has sent to himself, he then uses a paper notepad and pen to summarise the relevant points of the documents as they are discussed, and as he skims them via his iPad.

If Wesley makes any small notes on paper, such as the notes he sometimes takes using the abundant sticky-notes available at his office, he will usually photograph

these sticky-notes using the camera in his iPad. This will allow him to get rid of the paper copy of the note, as he prefers to keep his short notes in the iPad, because he finds them easier to act upon when they are there.

Because Wesley keeps so many of these small notes on his iPad, he often feels like he has problems managing and finding them, because they mount up so far on the iPad. When he used to use solely paper for such things, they got thrown away when no longer needed, but now they stick around because they are on the iPad.

**Summary of Wesley** Wesley represents an individual who:

- takes many photos of micronotes;
- has trouble remembering and using the context of documents left open on their computer;

#### 7.3.2.5 Discussion

This section has reviewed the makeup of the contemporary cross-platform PIM ecosystem in which the participants across all three phases of this research work. The section presented a review of the typical make-up of the office environment encountered amongst participants, as well as three personas that showcase the most prevalent participant behaviours and experiences in the research.

An understanding of the typical environment in which contemporary cross-platform PIM is conducted, as well as common behaviours amongst knowledge worker practitioners of cross-platform PIM is beneficial to future study of PIM and development of products. Through this study, the extremely cross-platform nature of PIM can be seen in detail —future work should further explore this, combining it with further explorations of the cross-tool nature of PIM to build a more complete picture of the way in which people actually get things done.

### 7.3.3 Paper and PIM

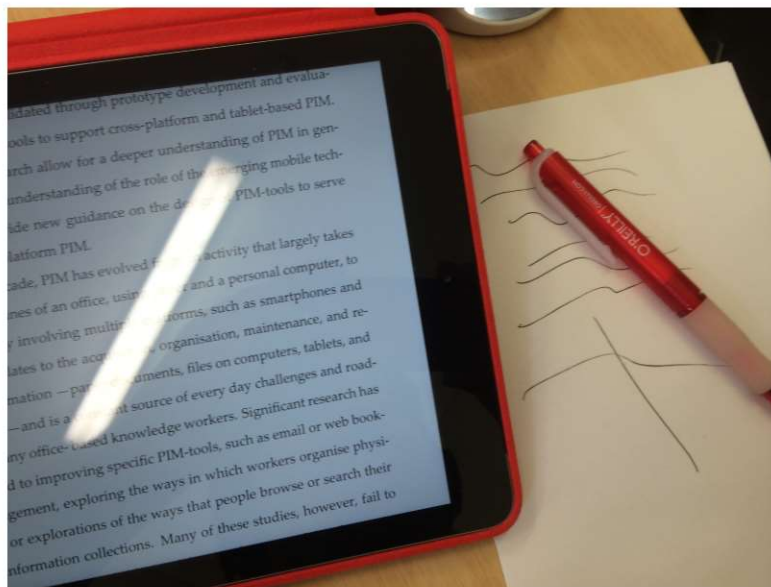
This section discusses how, and why, paper and paper documents are used for PIM in a cross-platform PIM environment, particularly alongside tablet technology. This topic was first touched on in the thesis in [Section 3.6.6](#) following the discussion of the results of the pilot study, and was further explored in [Section 4.5.4](#) following the exploratory study.

Whilst paper was one of the three core PIM-platforms of interest to this research —as was established in [Chapter 3](#)—it was not the focal platform of the research. That said, one particular observation regarding the use of paper alongside tablets made



throughout the three phases of research warrants a brief discussion/diversion: participants across all three studies reported that they had significantly reduced their paper consumption for scrappy micronote purposes, but had increased the amount of paper documents that they printed. This finding was also reported by the researcher in [Buttfield-Addison et al. \(2012\)](#).

At the conclusion of the pilot study, in [Section 3.6.6](#), it was noted that the number of participants who had acknowledged that they formerly kept paper for scrappy notes —information scraps, or micronotes —but since acquiring a tablet had started both using the tablet for such things or immediately transferring the micronote to the tablet and discarding the paper was high. These participants typically reported that they acted upon the information found in these micronotes more frequently, but found it hard to manage them because they simply *"mounted up on the tablet"*. This accumulation of eventually unnecessary information, where deletion is avoided, has been given many names —*"prospect theory"* in psychology, for example ([Kahneman and Tversky, 1979](#)) —and is reported in many PIM studies, for many different facets of PIM (e.g. [Whittaker and Sidner, 1996](#); [Abrams et al., 1998](#); [Boardman and Sasse, 2004](#); [Jones, 2004](#); [Kirk et al., 2006](#); [Whittaker et al., 2010](#)).



**Figure 7.12:** An example of participants typical setup when making notes on paper from a document displayed on their tablet

These observations were incorporated into the design of the exploratory study, and more intriguing observations regarding paper and cross-platform PIM arose following the exploratory study. Participants again stressed that they had moved this form of note-taking from paper to their tablets. They again explained they found these micronotes easier to act upon, and suggested that they had significantly decreased the

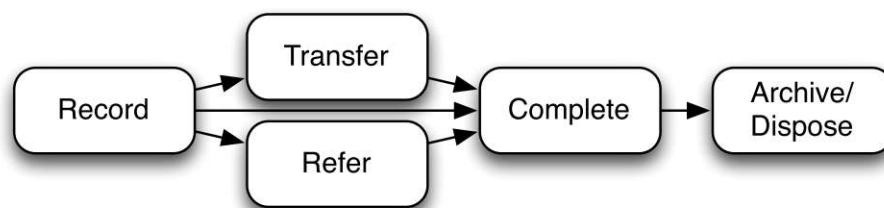


amount of paper that they kept around for micronotes following their use of a tablet. Many exploratory study participants reported that they used their tablet camera to *"copy the note into the tablet, so I can get rid of the paper"* —the use of the camera in this way was a fairly common transfer technique amongst participants at all stages of the research, as has been discussed.

Again, these observations were integrated in the case study. The case study gave rise to the following two observations:

1. eleven of the twelve case study participants reported, unprompted, that they felt they used paper —primarily specialised micronote paper, such as sticky notes —a lot less for noting micronote-style information, and reported that their tablet had mostly supplanted paper for this form of usage;
2. conversely, the same eleven participants reported that they used paper —primarily *"blank sheets stolen from the printer"* and notepads —a lot more, for making notes based on information they used their tablet to display, an example of this is shown in [Figure 7.12](#).

[Lin et al.'s \(2004\)](#) micronote lifecycle here presents an invaluable lens which can be used to discuss these findings. [Lin et al.'s \(2004\)](#) framework, particularly the *record*, *transfer*, *refer*, and *completion* stages, is essential to understand what role the tablet is taking in individuals' PIM here. [Lin et al.'s \(2004\)](#) micronote lifecycle is shown in [Figure 7.13](#).



**Figure 7.13:** [Lin et al.'s \(2004\)](#) micronote lifecycle

In the *record* stage of the lifecycle, which involves the capture or creation of micronotes, a comparison between the output of the case study and the output of [Lin et al.'s \(2004\)](#) study serves to illustrate both the changing times as well as the rapid incorporation of the tablet into people's daily activities: in [Lin et al.'s \(2004\)](#), only a single participant of the 29 did not use paper for recording micronotes, in the case study presented in [Chapter 6](#), 11 of the 12 case study participants suggested that the tablet was the primary and preferred information acquisition device for micronotes —and data was similarly overwhelming in the pilot study and exploratory study.

The opportunistic behaviour around PIM observed by past studies (Lin et al., 2004; Bernstein et al., 2008) was again on display here; participants in the case study mused that their tablet typically only replaced paper as it was *"the closest thing useful to make a note on"*. Tablet-using participants of the pilot study observed that they *"feel safe putting the information into the iPad because I'm not going to lose it or the cleaner won't throw it away or something"*; because of this, they observed *"I'm more likely to actually make a note, because I feel confident it's not going anywhere when it's in the iPad."*

Many participants across all three studies observed that *"paper is less flexible than the iPad, it doesn't sync anywhere, I have to write legibly if I use paper, and I can't email it to people!"* The emphasis on ease of accessing previously created micronotes and transferring of such notes has further implications in later stages of the micronote lifecycle. Participants also expressed that they felt like they were *"wasting time"* if they forgot to bring their tablet with them and had to make a note on paper instead *"because then I have to waste time later copying it into the iPad or my computer"*. Participants in the pilot study suggested that they *"often transcribed notes made on stickies or documents into the iPad because it feels more permanent"*, but complained that *"this makes me feel like I'm creating more work for myself because I end up with a few copies of my info!"* This sentiment was reinforced by exploratory study and case study participants.

Across all three studies, participants used a variety of PIM-tools to take micronotes on their tablet; reports of fragmentation were common: *"Sometimes I put a note in Pages [Apple's word processor], sometimes in Evernote. It gets kind of confusing figuring out where I put stuff."* As discussed in Section 2.2.3, fragmentation is a classical PIM problem, and the outputs of the three studies suggest that tablet use, particularly for micronotes, may be causing a cross-tool fragmentation problem (Boardman, 2004).

In the *transfer* stage of the micronote lifecycle, the tablet also appeared to impact things; in Lin et al. (2004), it was reported that information often had to be preserved whilst an individual was unable to use their usual infrastructure: for example, a sticky note created whilst an individual was on lunch break, meaning that the note was destined, from its creation, to be swiftly utilised or transferred to a more permanent form. In all three phases of this research, tablet users defied this, instead preferring to create their notes on the tablet: *"Why would I use a sticky note when it's always available and searchable on my iPad?"* was a common sentiment.

Tablet users reported additional benefits as they *"can email my iPad-based note to my colleagues with minimal editing, and that's something I do all the time"*. Participants expressed concern over the messy and time-consuming nature of paper-based micronotes, *"If the stuff on my scraps of paper needs to be passed on to workmates, I feel bad because it's so messy and it takes a lot of time to either type it up or rewrite it so I can email or photocopy it for them"*, suggesting that their use of their tablet for such notes avoided such concerns. This



suggests that the digital nature of the micronotes, with their inherent advantage of legibility over hand-written text, acts to reduce the cognitive overhead involved in transferring and interpreting other's information scraps.

The *refer* stage of the lifecycle involves referencing — making use of — a micronote; this usually involves noticing the note and interpreting its content. Participants in the present study had difficulties referring to their digital micronotes in a timely manner, despite past research (e.g. [Intons-Peterson, 1993](#)) suggesting that those using digital devices are up to twice as likely to remember to act on a note ([Lin et al., 2004](#)). In all three phases of the present study, tablet users reported that they "[have a] tendency to forget about notes I'd made in the iPad, so by the time I find them they're not so useful". Study participants did report, however, that the use of the tablet for micronotes improved the legibility of referring to past notes: *"I couldn't read a thing from my old paper notes even a day after writing them. It was worse than trying to read a medical prescription! I can always figure out what I meant in my iPad notes."* Past studies have noted that interpreting the handwritten note can be a painful process, so it appears that the tablet renders an improvement here ([Lin et al., 2004](#); [Bernstein et al., 2008](#)).

In final stages of the micronote lifecycle, *completion*, *archiving*, and *disposal*, a micronote has been acted upon or otherwise utilised and will not be required again; following this, the information is either disposed of or archived ([Lin et al., 2004](#); [Bernstein et al., 2008](#)). Past studies have reported that paper micronotes are often kept for long periods, sometimes years ([Lin et al., 2004](#); [Bernstein et al., 2008](#)); the outputs of the three phases of this study are no different — at least when it comes to paper — participants noted that they *"keep far too much of the paper scraps and documents I've scribbled on"* and that *"the old useless paper I keep around makes it a lot harder to find the stuff I actually want or need to find still!"*

When discussing the use of the tablet for micronotes, however, participants typically reported that they *"I keep as much old information as I used to in the iPad, but it doesn't feel like it's interfering with my ability to find relevant stuff now."* The low storage requirements of text and other formats common in micronote taking mean that there is very rarely any requirement to discard notes on the tablet in order to make room for more, which we found contributed to a sense of never needing to delete notes. Many participants, however, suggested that they faced a fragmentation problem due to their heavy tablet usage for micronotes, with participants suggest they were *"afraid that [their] stuff was becoming messier due to the iPad, because of all the notes I make in the iPad and eventually copy part of or all of elsewhere, I end up with more copies of the same thing than I would've had previously."* The fact that many software PIM-tools backup stored information, and automatically duplicate notes and documents on the user's desktop computer system in order to make stored content more available to the user contributed to this fragmen-



tation.

### 7.3.4 Summary

In summary, past research treated the PIM ecosystem as something that typically involved a single PIM-platform, or a collection of PIM-tools running on a single platform. Little was done to explore the ways in which PIM was conducted on and between multiple platforms.

This section has shown that the make-up of the typical PIM ecosystem observed and reported through the three studies encompassed by this work involves multiple PIM-platforms, being used in different ways, and being used together. Tablets and paper, particularly, have uses and relationships to each other that are neglected or unreported by past work.

Future research and product development can make use of this revised understanding of the contemporary PIM ecosystem to research for, and develop products for, the environment and ways in which people are actually conducting their PIM.

This section has addressed the objectives of the work, originally presented in [Section 1.2.1](#), by presenting a summary of the contemporary PIM ecosystem, with reference to the empirically-grounded model of cross-platform PIM that was developed through this research, as well as the prototype software PIM-tools that were explored and evaluated.

## 7.4 PIM-tools

This section draws upon both the conceptual model presented in [Section 7.2](#), and reflects upon the understanding of the ecosystem presented in [Section 7.3](#), as well as the exploration and evaluation of the prototypes that were developed, to explore the technical requirements, user experience needs, and evaluation techniques for the development of and future research into PIM-tools designed to support contemporary cross-platform PIM.

As was showcased in [Section 2.2.4](#), a vast range of primarily software-based PIM-tools exist in both the research and commercial domains of PIM. Likewise, throughout the three phases of this work, beginning with the initial results of the pilot study that were presented in [Section 3.4](#), and spanning throughout the interviews and diary studies conducted with participants in the exploratory study and case study, participants reported using a range of PIM-tools. One of the core objectives of this research was supporting the development of software PIM-tools.

[Rogers \(2004\)](#) suggestion that research should be prescriptive, providing guidance

for design, is upheld in this research —in addition to providing guidance on the design of future PIM-tools —by exploring the ways in which such tools can be evaluated, and identifying the most prevalent problems with existing design.

Here, again using the tablet as an exemplar platform, the latter two pillars are explored in the following sections:

- [Section 7.4.1](#) reflects upon the evaluation of the three PIM-tool prototypes (the development of which was presented in [Chapter 5](#)) that was conducted as part of the case study reported in [Chapter 6](#);
- [Section 7.4.2](#) discusses the most prevalent user experience issues reported by study participants in existing PIM-tools, and reviews recommendations and essential features for future, cross-platform PIM-friendly, software PIM-tools;
- [Section 7.4.3](#) concludes the section with a summary of the issues with current, and requirements for future PIM-tools.

#### 7.4.1 Contribution to Evaluating PIM-tools

The effective, genuine, and successful evaluation of software PIM-tools has long been acknowledged as a challenging issue in PIM research. The techniques and challenges of PIM-tool evaluation were first touched on in this thesis in [Section 2.3.4](#). This section discusses and reflects upon the methods used and choices made in the evaluation of the three iPad software PIM-tool prototypes constructed as part of this research project:

- Prototype 1 *context of printed documents*;
- Prototype 2 *emails to self*;
- Prototype 3 *cross-platform open document context*.

Two evaluations of the software PIM-tool prototypes —the construction of which was reported on it [Chapter 5](#) — were conducted:

- an initial evaluation, reported in [Section 5.7](#), focused on exposing critical issues with the prototypes' design and identifying any significant software bugs;
- an evaluation conducted as part of the case study reported on throughout [Chapter 6](#), focused on both validation of the prototypes' utility, and the conceptual model of cross-platform PIM under development.



This discussion focuses the evaluation conducted as part of the case study; the initial valuation was largely inspired by industry standard software engineering user tests as it was intended to insure that the prototypes were suitable for use in the case study. Thus, whilst it was useful, and interesting in its own right, it was not unique.

The evaluation conducted through the case study drew inspiration from the suggestion that elements of the ISO 9241 standard for the core concepts of usability are useful for PIM evaluation (Jones and Teevan, 2007), measures of performance, adoption and use, as well as Csikszentmihalyi's (1997) flow.

Two types of data made up the evaluation of the software PIM-tool prototypes: automatically-collected data, and qualitative feedback. The automatically-collected data was gathered through the data logging performed by the prototypes, and the qualitative feedback was collected through the interviews and diaries used at various stages of the case study.

The data collected through the use of the automatic data logging allowed the researcher to validate the statements made by participants in the case study regarding their use of the software prototypes. Instead of relying on participants' memories as to how much, and how frequently they utilised the prototypes, logged data was able to supplement the discussion and diary reports; this provided a vivid picture of the adoption (so much as something can be adopted in a short period) and use of the prototypes.

Neither of the potential caveats of automatic data logging, noted previously in Section 5.3.3, were encountered; the data files, as designed, were straightforward to parse and build an understanding of, and —likely due to the detail of the log files, as well as the significant time dedicated to discussing prototype use with case study participants —there were no problems determining the context of the data collected (Curtis et al., 2002; Fitton et al., 2004).

```
1e2ee9c8d57223529304caa5734b5ac021eb5e3e,1358917442,read_ipad  
1e2ee9c8d57223529304caa5734b5ac021eb5e3e,1358917466,read_ipad  
1e2ee9c8d57223529304caa5734b5ac021eb5e3e,1358917475,read_ipad
```

**Figure 7.14:** *Example of the log generated by one of the iPad prototypes*

An example of one of the log files from the prototypes is shown in Figure 7.14. This, alongside discussions and diary reports from participants regarding their performance using the prototypes tools raised the level of confidence regarding the outcomes of the evaluations (Jones and Teevan, 2007; Boardman, 2004).



The primary facets that were being explored with regards to the evaluation of the PIM-tool prototypes, as discussed in [Section 6.3.2.3](#), were: *effectiveness*, *efficiency*, *satisfaction*, and *flow*. *Effectiveness* and *efficiency* were explored by discussing whether the participants were able to accomplish the tasks that the tool was designed to support successfully, how they felt about their work in doing so, and how long things took compared to doing so without the tool ([Sun and Kantor, 2006](#); [Kelly and Teevan, 2007](#)). In the case of the three PIM-tool prototypes, each was constructed with a set of core functionality and usage scenarios in mind —these were previously discussed in [Chapter 5](#) —by discussing whether they were able to accomplish these scenarios with participants, a reasonable understanding of the effectiveness and efficiency of the PIM-tools was gained.

Similarly, *satisfaction* with both the existing cross-platform PIM practices of participants, as well as the practices they encountered when using the PIM-tool prototypes, were discussed at length. Participants discussed whether they felt their needs were met by the PIM-tool prototypes and how they felt with regards to being able to concentrate on important aspects of their work, instead of being distracted by the mundane aspects of PIM ([Czerwinski et al., 2001](#); [Kelly and Teevan, 2007](#)). By discussing how much time they felt they wasted, both before and after using the prototypes, a reasonable conception of participants' *flow* was able to be gained ([Csikszentmihalyi, 1997](#); [Bederson, 2004](#); [Kelly and Teevan, 2007](#)).

In summary, conducting a useful evaluation of PIM-tools is every bit as challenging as past research has suggested it is; the highly subjective nature of PIM means that users express themselves in unique and inconsistent ways when discussing their habits, which requires a great deal of coding and recoding during analysis in order to normalise the ability to present and discuss their experiences.

The evaluation conducted during the Phase 3 case study was successful, in that it provided a great deal of relevant data regarding how participants used the prototypes, and whether the prototypes were addressing genuine needs or otherwise, but the data —beyond the raw usage logs —was all highly subjective. It is argued that this, in this case, is acceptable —the objectives of the PIM-tools, as discussed in [Section 5.2.1](#), were geared around the exploration of the problems of cross-platform PIM with tablets, using the prototypes to gain a deeper understanding of these, and making initial recommendations regarding the future evaluation of such PIM-tools. The outputs here successfully serve these objectives.

In the future, an attempt to normalise the incoming data by using Likert-style ([Maurer and Pierce, 1998](#)) scales when querying participant feeling around their effectiveness, efficiency, and satisfaction may assist in better understanding and comparing participant experiences.

**How the prototypes were used** The prototypes that were developed in [Chapter 5](#), due to their automatic data logging capabilities, allow some light to be shed on the timings around how case study participants conducted their cross-platform PIM. For example, participants used their iPads to retrieve more than 75% of the emails that they had sent to themselves from their office computer within 8 hours of having sent the email, more than 50% within 3 hours, and 25% more than a day later.

Discussions with participants suggested that these timeframes were typical of their use of emails sent to themselves and the use of the email prototype did not impact it one way or another. However, participants did report that they found themselves making use of emails sent to themselves more often, and suggested that this was due to the prototype making it easier for them to retrieve these emails.

Likewise with the printing prototype, participants reported that they felt they wasted less paper, as they were *"able to identify what the hell was printed"* more often and, as a consequence, suggested that they *"got more done and chucked out less paper"*. Data logged by the printing prototype lends credence to this, with more than 50% of printed documents later being retrieved by participants using the prototype iPad application.

Across the 272 unique documents opened by participants whilst the open-document prototype was in use, 182 were accessed again via the prototype's iPad application. Participants unanimously reported that they were *"far more confident with what was going on when [they] got up to leave the computer [taking their iPad with them]"*.

## 7.4.2 User Experience

This section presents a combined discussion reporting on the user experience of PIM-tools. The discussion is presented in the following two sections:

- [Section 7.4.2.1](#) reports on the user experience issues in existing software PIM-tools discussed by participants throughout the pilot study, the exploratory study, and the case study;
- [Section 7.4.2.2](#) presents a review of recommendations and essential features for future software PIM-tools to support cross-platform PIM, with a focus on the tablet.

### 7.4.2.1 Existing PIM-tools

The results of the pilot study, and a number of the studies discussed in [Chapter 2](#), provided initial evidence of dissatisfaction regarding current software PIM-tool interfaces. The seeds of this discussion were set throughout the findings reported in



[Section 3.6](#); the exploratory study continued this theme, and this section reports further on the experiences of participants from both the exploratory study and the case study.

The vehemence of discussion and frequency of recurring problems that affected participants of the pilot and exploratory studies was significant. Since PIM is an ongoing and often repetitive everyday activity, it appeared that even relatively minor short-term problems (e.g. inconvenient interface support for naming files) can build up and have a negative impact on ongoing user experience (e.g. perceived level of control). In the exploratory study, a wide range of problems and concerns were raised by participants relating to all PIM sub-activities of Barreau's (1995) model in a number of iPad PIM-tools. Furthermore, issues varied significantly between participants. This section highlights the most prevalent issues.

As the researcher considered the findings from the pilot study, it became apparent that the majority of them were failings of user experience with the PIM-tools and PIM-platforms used by participants to conduct their affairs. In [Section 3.6](#) the most prevalent user experience problems —or missing features— identified, across the facets of PIM discussed, were:

- lack of support in iPad software PIM-tools for taking photos of paper;
- email's unsuitability for sending information to oneself;
- difficulty maintaining context on the iPad when working with documents recently printed from or read on a desktop computer;
- "*tagging fatigue*" due to iPad software PIM-tools presenting tagging as a central organisation option;
- duplicate content accumulating in software PIM-tools, due to the inability of such tools to identify duplicates;

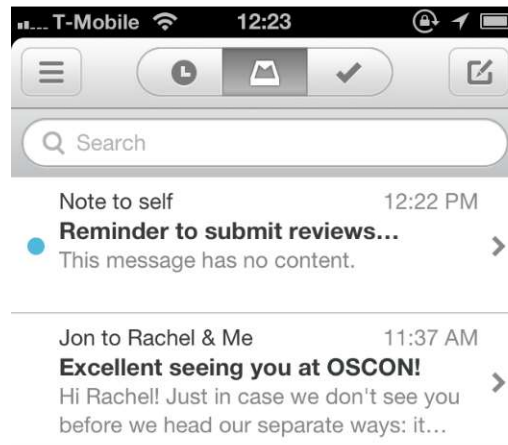
The data from the exploratory study again suggested these as user experience problems, and they were again identified as the most prevalent during the case study. "*Tagging fatigue*" is further discussed in [Section 7.4.2.2](#).

**Examples of existing PIM-tools** A number of existing software PIM-tools employ techniques similar to the recommendations made in this thesis in their design and implementation. Existing software PIM-tools were previously explored in [Section 2.2.4](#).

Popular iOS email client application Mailbox ([Dropbox, Inc., 2013](#)), for example, employs a number of strategies recommended by the findings of this research. Specifically, Mailbox displays emails sent from the user to their own email address in a slightly



different manner to the rest of their emails; the visual treatment of this feature used by Mailbox is shown in [Figure 7.15](#).



**Figure 7.15:** A screenshot showing the ability of the iOS app, Mailbox, to identify emails from the user to themselves

The latest version of Apple's Mac OS X personal computer operating system, OS X Mavericks, has in-built support for tagging ([Apple, Inc., 2013b](#)); the feature is described by Apple using a scenario that would address a prevalent challenge faced by many participants in the studies reported on here. [Apple, Inc.'s \(2013b\)](#) marketing material notes:

*"Tags are a powerful new way to organise and find your files ... Simply tag files you want to organise together with a keyword, like 'Event'. Then when you want to find those files, just click 'Event' in the Finder sidebar or enter it in the search field. Tag a file once, or give it multiple tags to assign it to multiple projects ... tags let you group them together into projects. So if you're planning an event, you could tag the guest list you saved in Numbers, the flyer you designed in Pages, and the presentation you created in Keynote, and see them all with just one click — organised as a single project in a single Finder window."*

Evernote, the popular software PIM-tool ([Swallow, 2013](#)), for example has an in-built camera-based feature — shown in [Figure 7.16](#) — in its mobile version for tablets and smartphones that is specifically designed to take photos of paper. This feature, as shown in [Figure 7.17](#), has recently been expanded to specifically support sticky notes, allowing users to define automatic tags applied to photos of sticky notes based on the colour of the note ([Evernote, Inc., 2013b](#)). Evernote was first discussed in this thesis in [Section 2.2.4](#).

iCloud Tabs, a feature of recent versions of Apple's Safari web browser, provides



**Figure 7.16:** An example of Evernote's ability to automatically align photos of paper documents taken through their mobile app



**Figure 7.17:** Evernote's automatic categorisation feature for photos of sticky notes



a potential solution to cross-platform web content syncing ([Apple, Inc., 2014](#)). It allows users to view the tabs they have open across their various devices.

A number of other —recently introduced —commercial software PIM-tools also serve to, positively, suggest that PIM-tools may finally be considering cross-platform needs and behaviours. PDFpen, a popular application for the iOS platform, recently introduced a "*scanning*" mode ([SmileOnMyMac, LLC., 2013](#)), for example —this mode is designed, similar to the Evernote feature noted above, to allow users to easily transfer paper information to their phones and tablets.

These examples are positive indications that commercial domain PIM-tools may be heading in the right direction in terms of supporting cross-platform PIM.

#### 7.4.2.2 Future PIM-tools

This section utilises the conceptual model of cross-platform PIM, alongside anecdotal evidence from the three phases of this research, to discuss how the conceptual model implies a number of capabilities that PIM-tools and PIM-platforms must have in order to allow for effective cross-platform PIM, as well as to suggest three specific example recommendations for future PIM-tool and PIM-platform capabilities. The three capabilities discussed here were also reported on it [Buttfield-Addison et al. \(2013\)](#).

Each of the added components (transfer and contextualisation) —PIM-tasks —implies a number of capabilities in future PIM-tools in order for them to better support that PIM-task and its PIM-support tasks.

As shown by the conceptual model, *transferring information* between platforms and *contextualisation* are such fundamental PIM-tasks for cross-platform PIM that the researcher was extremely surprised at the lack of solid support for them in existing PIM-tools and PIM-platforms, as reported by study participants.

Future tablet software PIM-tools, by supporting such transfer-related capabilities as improved camera abilities for the capture of paper documents, and such context-related capabilities as better contextual awareness of recently printed documents, will allow individuals to better manage their cross-platform PIM with respect to transferring and contextualising between platforms. In general, if PIM-tools and PIM-platforms are going to better support those who practice cross-platform PIM —which, as has been established, is the majority of users —then they are going to need to provide means for users to *transfer* and *regain context* as swiftly and efficiently as possible.

It is important to note that these recommendations do not always align with the workarounds employed by users in an existing environment; for example, just because a preponderance of users uses their iPad camera to transfer information from paper into the iPad does not necessarily mean the only or most applicable route for-

ward is to better support taking photos of paper with the iPad camera. Other solutions, for example, in this case, might be to better support the kind of information creation that users perform with the paper on the iPad.

In developing future software PIM-tools, variables such as those presented earlier in [Section 7.2.3](#) — and those presented in other research, such as ([Bergman, 2013](#)) — are useful. The impact of different tools and their design on the variables can be explored, as well as the impact different axes of the variables have on other elements of PIM, such as productivity, effectiveness, or flow.

**Example Capabilities** Three of the most prevalent capabilities, as suggested by study data, for future PIM-tool and PIM-platform are:

- *input capabilities*
- *linking capabilities*
- *tagging capabilities*

The first capability, "*data input*", was identified as a significant point of consternation for users of iPad-based PIM-tools. The iPad alone effectively offers three means for text input: the on-screen keyboard, the camera, and the inbuilt voice recognition of certain versions of the iPad. The revelation that a number of participants across all three studies used the camera as one of their primary input means for PIM (often using Evernote) was intriguing; P6 of the semi-structured interviews in the exploratory study provided a description typical of these participants:

*"the way I take most of my notes in Evernote is by taking pics [sic] of the pages in my notebook. It's kind of painful to take a picture, save it, then take another one when really they're all pictures of the same set of notes and should be stored as one note in Evernote"*

While this data input technique could, perhaps, be equated to the use of a desktop scanner with a traditional personal computer, user interfaces and workflows within software, such as the Evernote app discussed here, are not at all geared towards this use-case. Effective support of input will also mitigate the use of sub-optimal strategies for "*transferring*" information.

The second capability identified was that of "*linking*" individual records together; as noted above, participants frequently used the device's camera to capture handwritten physical paper notes into the iPad — the interface for doing this, despite Evernote supporting multiple image files being store as one record, makes it difficult for users



to capture multiple related images into one document. P19 of the semi-structured interview component of the exploratory study provides an exemplary comment:

*"If I've scribbled all over my meeting notes I want to be able to take snaps of each page in say, a 10 page document, and store them all together. Evernote doesn't really make it easy to do that but I do it anyway and then store them in a folder or tag them so that I know they're related. I can't link them together without additional effort, so I just don't bother."*

This avenue may prove fruitful to future investigation. This theme links with the organisation and maintenance stages of the PIM model — linking records together appears to be a significant shortfall of the current range of available software for tablets, including Evernote, for the majority of our participants. Effective linking support will result in better management of "context" when moving between platforms — at the very least in the case of individual cross-platform PIM-tools.

The third of the most prevalent capabilities that surfaced repeatedly during this analysis was that of "tagging fatigue". Participants reported being stressed over the implication, as presented in the interface of the PIM software, that they needed to provide tags (keywords) for each record, feeling as though the software would make it difficult for them to locate the records again if they didn't tag. Many past studies, such as [Civan et al. \(2009\)](#), have discussed the experiences of users in tagging. P12 and P14, respectively, of the semi-structured interview component of the exploratory study provided comments that were typical of participants' perspective on tagging in Evernote:

*"I hate it. The UI makes me feel like I have to tag everything, and that I won't be able to find it again if I don't, but really search just works fine without tags applied and the continual appearance of tags, or the lack thereof, in the interface just makes me feel like I have more work to do to keep things organised."*

*"Tagging is so much extra effort, I have to think about my note too much more, what I want to use it for in the future, things like that, that I often just don't want to tag it. I really don't care, or know, if it [tagging] will even help me find it faster in the future."*

This an interesting contrast from much current scholarship in relation to tagging; recent work suggests that tagging might be the optimal solution for organising and re-finding information for certain groups of users ([Voit et al., 2012](#)). It is often suggested that tagging, as an act of categorisation, causes an individual to put more thought into the purpose and contents of the item being tagged ([Craik and Lockhart, 1972](#); [Jones](#)



and Teevan, 2007; Jones et al., 2012). Here, the findings suggest that individuals are highly aware of this additional mental overhead required from tagging and, correctly or otherwise, assume that the overhead is not worth the effort for potential benefits in future refinding. This theme relates to all the stages of the PIM model and suggests that a reappraisal of the role of tagging in, at the very least, tablet software PIM-tools, may be worthwhile.

Future PIM-tools need to ensure that they avoid "*tagging fatigue*": where software PIM-tools present tagging as such a central organisation option/requirement that users become stressed or anxious about tagging, with the end result that they do not tag at all.

The findings here underscore the conception that techniques for managing PIM collections differ across different technologies (such as laptop computers, desktops and tablet computers), and the strategies that individuals use are affected not only by the choice of software, but by the hardware features and form factor of the device the software is used on. Prior investigations of how people utilise PIM software tools have largely been focused on traditional desktop operating systems, and lack a cross-platform focus.

The three capabilities identified above demonstrate that extant PIM software for tablet computers is frequently failing to address many PIM, and cross-platform PIM needs. From these findings, future research can offer suggestions for improved design of PIM software on tablet computers, including, for example, the development of more nuanced options for image capture using the camera, improved linking capability between existing and new notes, and improved, or removed, tagging interfaces to allow users flexibility in their choice to tag. Existing applications fail to meet many needs of the users discussed here, resulting in a variety of hacked improvisations.

### 7.4.3 Summary

This section has reiterated the challenges of evaluating PIM-tools effectively and successfully. The evaluation of the software PIM-tool prototypes that was conducted as part of the case study was discussed, and the variables and factors that played a part in that evaluation. Participants' experiences with existing PIM-tools, and recommendations for future tools were also discussed.

This section has addressed the objectives of the work, originally presented in [Section 1.2.1](#), by building further, empirically-grounded understanding of cross-platform PIM through discussion and recommendation of capabilities necessary for the construction and development of software PIM-tools designed to support cross-platform activities and requirements.

## 7.5 Conclusions

This chapter has discussed the substantive findings from the case study presented in [Chapter 6](#), the pilot study presented in [Chapter 3](#), and the exploratory study presented in [Chapter 4](#). The discussion was compromised of the following sections:

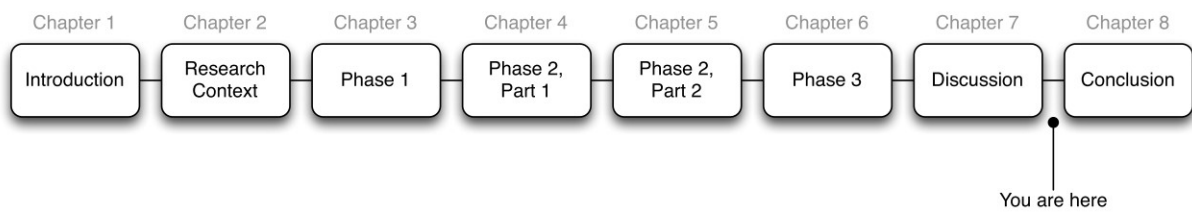
- [Section 7.2](#), using the tablet as an exemplar, discussed the model of cross-platform PIM that was developed over the course of the research;
- [Section 7.3](#) discussed the cross-platform PIM ecosystem highlighted by the research, summarising the most prevalent cross-platform PIM behaviours, challenges, and approaches observed and reported by the knowledge workers who participated in the research;
- [Section 7.4](#), with a cross-platform focus, discussed the evaluation of PIM-tools and common user experience problems with existing PIM-tools reported by participants.

The discussion has served the objectives of the thesis, which were reiterated in [Section 7.1](#), by:

1. presenting an expanded version of [Barreau's \(1995\)](#) model of PIM, allowing for the description of two additional facets involved in cross-platform PIM: *transfer* and *contextualisation*;
2. presenting a number of variables useful for describing and characterising cross-platform PIM, as well as a discussion on how the variables and model could be applied to future work;
3. summarising the state and constituent make-up of a typical contemporary PIM ecosystem;
4. presenting a discussion of how the software PIM-tool prototypes developed were explored and evaluated, and a number of recommendations for future evaluations;
5. summarises participants' experiences with software PIM-tools, and making recommendations for future software PIM-tool capabilities to support cross-platform PIM.



[Chapter 8](#), following, concludes the thesis with a review of the key findings, contributions, methodologies employed, limitations, and angles for future work.





*Essentially, all models are wrong,  
but some are useful.*

—G. Box and N. Draper

# 8

## Conclusion

**T**HIS chapter concludes the thesis by reviewing the main findings, contributions, methodology, limitations of the research, and angles for future work.

### 8.1 Introduction

The overarching and initial premise of this research was that *there is insufficient research exploring modern cross-platform personal information management (PIM), as performed by knowledge workers*. This chapter returns to that initial premise, provides an overview of the approach taken to explore it, the results obtained, reflections on doing so, and possible angles for future work.

Following the review of past practice and research, reported on in [Chapter 2](#), the following observations arose:

- there was a lack of research into the use of tablet technology for PIM;
- there was a lack of research into the practice of cross-platform PIM: PIM activities conducted or related to multiple PIM-platforms;
- specifically, little is known about the relationships between different PIM-platforms, and the differing ways in which they are used;
- the research-practice gap ([Sutcliffe, 2000](#); [Rogers, 2004](#)), where HCI research outputs can be irrelevant to the real-world needs, is ominously lurking throughout PIM research ([Kljun et al., 2013](#)).

From these observations, and together with the original premise, the three high-level objectives, and the focus of the research, were developed as follows:

1. to develop an understanding of PIM practices involving modern tablet technology;
2. to propose and evaluate an empirically-grounded model of cross-platform PIM;
3. to propose, implement, and evaluate a number of prototype software PIM-tools that address typical cross-platform PIM challenges.

These objectives were designed to focus the exploration of the initial premise, and were previously stated and discussed in [Section 1.2.1](#). To address these objectives, a three-phase study was conceived. The three-phase structure was first presented and discussed in [Section 1.3.2](#). The phases were:

- **Phase 1:** The first phase, a pilot study consisting of online questionnaires and semi-structured interviews, was designed to confirm the research focus and context of the tablet, as well as to establish a number of prevalent focal points for the research. The most common PIM-platforms and software PIM-tools were identified, and the focus on the tablet validated.
- **Phase 2:** The second phase, an exploratory study consisting of online questionnaires and semi-structured interviews, and a round of prototype development, was designed to explore the focal points in-depth, with a focus on the role of the tablet. The challenges of using tablets for cross-platform PIM were highlighted, and specific facets of PIM were explored. Three prototypes were also conceived and constructed in this phase.
- **Phase 3:** The third phase, a case study, evaluated potential solutions to problems identified in the first two phases and provide data in order to describe cross-platform PIM in a conceptual sense, using the tablet as a case study.

This project identified a significant gap in the research and understanding of the behaviours and activities surrounding cross-platform PIM — PIM activities conducted or related to multiple PIM-platforms, such as across tablet computers, personal computers, and paper documents. The research confirmed the scope of the gap, identifying a number of common behaviours, workarounds, and activities in participants across three phases of exploration.

The resulting extension of [Barreau's \(1995\)](#) model, adding components to account for cross-platform PIM, can be used by future research and product design to explore the area. The extended model was explored and evaluated through the development of three software PIM-tool prototypes, and subsequent deployment of the prototypes through a case study. This resulted in a number of recommendations for future software PIM-tool capabilities and evaluation methodologies.

### 8.1.1 Chapter Structure

In the remainder of this chapter, a review of contributions is provided, followed by a critical reflection on the work, suggestions for future directions, and a parting summary:

- [Section 8.2](#) discusses the contributions made;
- [Section 8.3](#) reflects on the limitations and considers the possibilities for future work;
- [Section 8.4](#) considers a number of avenues for future work;
- [Section 8.5](#) concludes with some parting words.

## 8.2 Contributions

This section summarises and synthesises the contributions made by the thesis as a whole. The contributions are situated in three categories: *substantive*, *theoretical*, and *methodological*.

The contributions arising from Phase 1, the pilot study, and previously discussed throughout [Chapter 3](#), are as follows:

- *theoretical*: exploration and unpacking of the challenges of transferring information and maintaining context between PIM-platforms;
- *substantive*:
  - identification and exploration of the most prevalent PIM-platforms and their facets, strategies, and challenges, with particular emphasis on tablet computers;
  - exploration of the use of tablet computers for micronotes, supplanting paper in ways, whilst supporting it in others.

The contributions arising from Phase 2, the exploratory study and prototype design and construction, and previously discussed throughout [Chapter 4](#) and [Chapter 5](#), are as follows:

- *methodological*: design and implementation of three software PIM-tool prototypes related to print documents, emails to oneself, and open-documents on office computers;



- *theoretical*: initial extension of Barreau (1995) model of PIM to account for cross-platform PIM, adding *transferring* and *contextualising*;
- *substantive*:
  - insights into the techniques and challenges faced when transferring information, organising information, and maintaining context between multiple PIM-platforms;
  - further exploration of the use of tablet computers for micronotes, supplanting paper in ways, whilst supporting it in others;
  - results from initial evaluation of the prototypes;

The contributions arising from Phase 3, the case study, and previously discussed throughout Chapter 6 and Chapter 7 are as follows:

- *methodological*:
  - design and evaluation implications from the prototype evaluation;
  - design recommendations for future software PIM-tools designed for cross-platform PIM environments;
  - design and implementation of a three-phase study, concluding with the case study, investigating cross-platform PIM and tablet technology;
- *theoretical*:
  - extended model of PIM strategies and requirements within a cross-platform PIM environment;
  - the identification of a number of variables suitable for describing the practice of cross-platform PIM;
- *substantive*:
  - New data on the use of tablet technology for PIM, particularly in a cross-platform PIM environment;
  - results from the evaluation of the prototypes during the case study;

**Implications from Substantive Contributions** The substantive contributions of the research come together to support the objectives by reporting on the tablet, and other most prevalent PIM-platforms, and the facets, strategies, and challenges around them, used by participants for cross-platform PIM. The substantial empirical data collected over the course of the three phases supported the development of the extended conceptual model to account for cross-platform PIM, and provided the impetus for the development, exploration, and evaluation of the three software PIM-tool prototypes.

No past research has effectively explored either cross-platform PIM generally, or the role of the tablet in PIM at all.

**Implications from Theoretical Contributions** The theoretical contributions of this research support the objectives by providing an understanding of the most prevalent facets of cross-platform PIM — transfer and contextualising — both through characterisation and the description of their nature, as well as the development of a number of variables and an extended version of Barreau's (1995) conceptual model of cross-platform PIM.

No past research has proposed a model or framework of PIM that sufficiently describes the peculiarities and requirements of cross-platform PIM, and no past research suggests variables to account for PIM includes cross-platform facets.

**Implications from Methodological Contributions** The methodological contributions of this research support the objectives by reporting on the design, implementation, exploration, and evaluation of three software PIM-tool prototypes that address some of the core facets of cross-platform PIM identified. The review of exploration and evaluation challenges provides guidance to future research and product development on the evaluation of similar tools, as well as a number of example design recommendations for future software PIM-tools designed for cross-platform PIM.

No past research has proposed or developed any software PIM-tools that specifically target cross-platform PIM, or seek to support existing work habits —improving the *status quo* without radical design, or reinvention.

## 8.3 Limitations

This section considers the overall success of the research agenda in addressing and exploring the objectives. The central, and most pragmatic limitation of the work performed for this research was the fact that the researcher acted as the sole researcher and software developer, performing all data collection, analysis and study design.

This limitation is a central proposition of a PhD thesis, but the researcher feels it worth acknowledging regardless. Other potential limitations include:

- the scope of the area under study: the office environment of knowledge workers;
- the technology choices related to the prototypes built and studies performed;
- participant recruitment and occupations;
- self-reported data;
- typicality of study period.

**Scope** The area of interest for this research was the office environment of knowledge workers. This area was selected as it allowed for the exploration of a popular area in which PIM is conducted, and the office and its surrounds have been the subject of myriad past PIM studies. Future studies might include explorations of how PIM is conducted across multiple platforms between a work office and a home office, for example.

**Technology** Study participants for the case study were also limited to users of the Apple OS X desktop operating system and the Apple iOS-based iPad tablet device —the reasons for this were previously discussed in [Section 5.3.2](#).

**Participants** Notably, all of the study participants in Phase 3 were employed by a firm offering legal services, and whilst this was done deliberately, the study findings may not generalise to workers in other types of organisations. The researcher is, however, confident that the findings will generalise to similar populations.

**Self-reported Data** The study, across all three phases of data collection, relied significantly upon participants' self-reporting for many characteristics of PIM. Whilst every effort was made to verify the accuracy of participants self-reported data, self-reported data can be less reliable and precise than more objective measures. The researcher feels that this risk is appropriate to the study, since it is a well acknowledged caveat of this type of research ([Lazar et al., 2010](#)). In the future, an attempt to normalise the incoming data by using Likert-style ([Maurer and Pierce, 1998](#)) scales when querying participant feeling around their effectiveness, efficiency, and satisfaction may assist in better understanding and comparing participant experiences, for example.



**Study Period** The typicality of the period used for the case study is an important consideration when considering the findings (Boardman, 2004). There are a number of external factors which may have had an impact upon participants' PIM activities during the case study:

- the study was conducted in the first working weeks of 2013, meaning that the activities conducted by participants' may not have been representative of a typical workload since the year was only beginning to ramp up;
- the novelty of iPad technology to participants was a concern, however all participants reported that they had owned an iPad, and made use of it for PIM, for at least a year at the time of participating;
- participants in the case study were largely all highly enthusiastic users and embracers of new technology —classic "early adopters" (Ram and Jung, 1994).

The variety of factors noted above highlights the challenges inherent with evaluating such a personal, daily, and embedded activity as PIM. Whilst most of these factors are beyond the control of any researcher, it is worthwhile to acknowledge their presence. Additionally, the use of the prototypes is likely to have some impact on participants' behaviour beyond the intended evaluation.

## 8.4 Future Work

This study was non-longitudinal in nature; a longitudinal study of the same facets of PIM, focusing on a specific group of knowledge workers over a larger period of time would be a useful complement to the present study and would provide useful additional validation and information on strategies used for cross-platform PIM involving the iPad. It would also provide information on patterns of iPad use over time, as well as the longer term lifecycle of the sorts of information used alongside and on the iPad during PIM. It would, however, be challenging to perform.

This research has, particularly, opened up a substantial new avenue for future empirical investigation of PIM: PIM conducted across multiple tools and multiple platforms, and how such PIM is conducted over time. An ideal future study might spend a year or more, using similar data collection tools as were employed in Chapter 6, to explore both cross-tool and cross-platform PIM in context, using improved data logging to capture transfer and contextualisation between platforms and tools; the objective of such a study would be to codify, categorise, and understand PIM across tools and platforms.

As part of this research, it would be interesting to explore the cross-tool, cross-platform PIM activities inherent in the completion of a large project from start to finish, or the conduct of PIM in non-work related settings. Other potential avenues for future work include:

- the exploration of the use of smartphones in cross-platform PIM;
- an exploration of happiness as a metric of tool success;
- the use of the task-artefact cycle, and other theoretical tools, in a formal manner;
- further development of broadly applicable and useful theory.

**Smartphones** An exploration of the use of smartphones as platforms in cross-platform PIM would prove beneficial to increasing our overall understanding of PIM. Smartphones were not included as a focus of the current study as, presently, they are not as homogenous as tablet computers; should they become as homogenous — as industry trends suggest they might ([Pew Research Centre, 2013](#)) — a study such as this one would become worthwhile and possible. Tablets are currently more consistent with each other.

**Happiness** Another intriguing facet of PIM-tool evaluation that should be explored in the future is happiness. Using happiness as a metric of tool or system success is occasionally mooted in both PIM- and HCI-literature (e.g. [Jones and Teevan, 2007](#)), but few studies — especially in the PIM domain — have been conducted. Future studies might also explored a micro-note focused prototype, as was suggested in [Section 5.3.1](#).

**Formal use of Theory** Evaluation and design go hand-in-hand, and design is never-ending ([Carroll, 2000](#)). As noted in [Section 2.3](#), the task-artefact cycle suggests that studying a task, and its context, give way to the requirements for the design of an artefact to support that task, and the artefact is then evaluated in the same context as the original task as the cycle continues ([Carroll et al., 1991](#)). Therefore, a significant avenue for future work is a study more formally based on the task-artefact cycle ([Carroll et al., 1991](#)), allowing for further development of a theoretical foundation for PIM. More extensive models and frameworks of cross-platform PIM could be developed through the application of other theoretical tools as well, such as activity theory ([Nardi, 1996b](#)), and distributed cognition ([Kirsh, 2001](#)).

**Broad Theory Development** Echoing the commentary of other researchers (e.g. [Boardman and Sasse, 2004](#); [Jones, 2012, 2013](#)), as was stressed in [Chapter 2](#), it is crucial that



PIM theory is accessible to designers lest it be ignored beyond academia. Further research on the evaluation of designs and tools is also critical; published evaluations of PIM research are still lacking in generally applicable evaluation guidelines. Future research should explore the further development of theory that provides outputs applicable to designers, such that the commercial domain —and others seeking to build better PIM-tools —can draw from it. Further development of variables, such as those presented in this work, as well as by past research such as [Bergman \(2013\)](#), is likely the most viable starting point for this.

Additionally, this work has taken a technical approach to the design intervention and prototyping —future work could build from this *technology centric* approach and explore potential social- or policy-centric interventions. Future work could also explore heavy users of tablets, as well as non-users —such users must exist, but were not encountered during this research.

## 8.5 Parting Words

As the research began, it was noted that *there is insufficient research exploring modern cross-platform personal information management (PIM), as performed by knowledge workers*. In addressing this, this research has contributed significantly on substantive, theoretical, and methodological levels. No past studies have been constructed, on a methodological level, designed, and implemented in a manner such as this, and no past studies have collected such a vast amount of empirical data, whilst also contributing on a theoretical level through the extension of a conceptual model.

This research has deeply explored the nature of cross-platform PIM, through the lens of tablet computers, and made a number of major contributions that future research and product development can build upon to better support this little-studied, yet ironically always-prevalent field and problem. Through studies such as this one, cross-platform PIM may one day live up to the ideals that we are presented with in popular culture!





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